ATTRIBUTIONS OF PAIN TO INFANTS:
A COMPARATIVE ANALYSIS OF
PARENTS, NURSES AND PAEDIATRICIANS

by

REBECCA R. E. PILLAI RIDDELL

B.A., (Spec. Hons.), York University, 1996
M.A., The University of British Columbia, 2000

A THESIS SUBMITTED IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE STUDIES

(Department of Psychology)

We accept this thesis as conforming
to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

March 2004

© Rebecca Pillai Riddell, 2004
Abstract

The limited ability of infants to communicate their pain and to moderate their pain experience places great importance on caregivers in accurately detecting when they are suffering. The goal of this investigation was to conduct a comparative analysis of the pain judgments of three major infant caregiver populations (parents, nurses and paediatricians) and the beliefs that each group held in regards to those judgments. This study finds theoretical grounding in the Sociocommunication Model of Infant Pain. In order to understand the role of beliefs in pain judgments, the current study controlled other variables postulated by Craig and colleagues to impact the communication between an infant in pain and his/her caregiver. Participants provided attributions of pain after viewing video clips of infants (from five different age groups) who had received a routine immunization injection. Between caregiver group differences and differences across the pain attributions to different infant ages were examined. Parents attributed greater pain than paediatricians, while nurses did not differ from either group. A systematic age bias in pain attributions was also found, in that younger infants were attributed significantly less pain. Finally, several secondary findings contributed to a clearer understanding of both these findings. Using self-reported importance ratings as an indication, between-caregiver group differences were found regarding how each sample made their pain attributions. As well, caregivers demonstrated different beliefs regarding the cognitive ability of infants of differing age groups. By elucidating infant pain attribution differences between caregivers and age groups, the current study helped determine possible factors responsible for the incidence of unrelieved infant pain.
# Table of Contents

Abstract ......................................................................................................................... ii  
Table of Contents ........................................................................................................ iii 
List of Tables ................................................................................................................ vi 
List of Figures .............................................................................................................. vii 
Acknowledgements ..................................................................................................... viii 
Introduction ................................................................................................................ 1  
Literature Review ........................................................................................................ 4  
  Evolving Conceptualizations of Pain in Infancy ......................................................... 4  
  Decoding Pain in Infancy ......................................................................................... 6  
    Physiological Indices of Infant Pain .................................................................. 7  
    Behavioural Indices of Infant Pain .................................................................. 8  
Current state of infant care in hospitals .................................................................. 16  
Longer-term consequences of unrelieved infant pain ............................................. 20  
  Physiological Sequelae ...................................................................................... 20  
  Behavioural and Cognitive Sequelae ................................................................ 23  
The Sociocommunication Model of Pain ................................................................ 28  
Research Examining Caregivers’ Attributions of Pain to Infants ......................... 31  
  Parents ............................................................................................................... 32  
  Physicians ......................................................................................................... 34  
  Nurses ............................................................................................................... 36  
  Comparative Work between Parents, Physicians and Nurses ......................... 39
| Social Perception: Adult Judgments of Infants | 42 |
| Nurses’ Pain Attributions | 46 |
| Encoder Variables: Infant Judgment Cues | 47 |
| Decoder Variables: Significant Nurses’ Characteristics in Judging Infant Pain | 50 |
| Research Synthesizing the Assessment of Infant Pain | 51 |
| Heuristic Decision-making | 55 |
| Methodological Notes | 57 |
| Overview of the Proposed Study | 58 |
| Methods | 61 |
| Participants | 61 |
| Procedure | 65 |
| Apparatus | 67 |
| Measures | 69 |
| Results | 72 |
| Demographics | 73 |
| Relationships Among the Pain Judgment Variables | 73 |
| Randomization Check: Effect of Video Clip Order | 81 |
| Primary Analysis: Profile Analysis on the Meta-pain Variable | 82 |
| Secondary Analyses: Examining Attitudes and Beliefs | 86 |
| Analyses Examining Overall beliefs | 86 |
| Analyses involving the Cue Importance Ratings and Belief Statements across the Age Groups | 88 |
Analyses involving the Belief Statements

Discussion

Implications for Theory

Implications for Clinical Practice

Suggestions for Future Research

Limitations of the Study

Conclusions

References

Appendix 1: Consent Form Sample

Appendix 2: Parent Advertisement

Appendix 3: Sample of Children Activity

Appendix 4: Nurse Advertisement

Appendix 5: Paediatrician Letter

Appendix 6: Newsletter Article

Appendix 7: Script

Appendix 8: Demographic Questionnaire

Appendix 9: Developmental Beliefs Questions

Appendix 10: Pain Intensity and Affect

Appendix 11: Capabilities Questionnaire

Appendix 12: Importance of Cues Questionnaire
List of Tables

Table 1: Demographic Characteristics by Sample Affiliation 74
Table 2: Correlations between Pain Judgment Variables for 2 Month Olds 76
Table 3: Correlations between Pain Judgment Variables for 4 Month Olds 77
Table 4: Correlations between Pain Judgment Variables for 6 Month Olds 78
Table 5: Correlations between Pain Judgment Variables for 12 Month Olds 79
Table 6: Correlations between Pain Judgment Variables for 18 Month Olds 80
Table 7: Principal Component Weights and Pooled Standard Deviations 81
Table 8: Profile Analysis: Estimated Marginal Means of the Meta-pain Variable 85
Table 9: Frequency Table: “At what age do you believe children can experience pain” 87
Table 10: Frequency Table: “At what age do you believe it is appropriate to begin to administer a pain-relieving medication” 87
Table 11: MANOVA on Importance of Cues Ratings for 2 month olds: Means (and Standard Deviations) for Follow-up Comparisons 89
Table 12: MANOVA on Importance of Cues Ratings for 18 month olds: Means (and Standard Deviations) for Follow-up Comparisons 90
Table 13: Discriminant Function Analyses of Importance Ratings of Cues: Standardized Discriminant Function Coefficients for Both Analyses 92
Table 14: Group Centroids for the Primary Discriminant Function on Importance Ratings for 2 month olds and 18 month olds 93
Table 15: Frequency Table: “Children of this age group understand pain” 96
Table 16: Frequency Table: “The setting a child of this age group is in can affect how much pain they feel”. 96
Table 17: Frequency Table: “The mood of a child in this age group can affect how much pain they can feel” 97
Table 18: Frequency Table: “Children of this age group cannot remember pain” 97
List of Figures

Figure 1: The Sociocommunication Model of Infant Pain 30
Figure 2: Means on the Meta-Pain Variable: Sample Groups by Age Groups 83
Acknowledgments

This work is dedicated to the memory of both my parents, Francis and Doris Pillai. Their lives are a source of inspiration, as I learned everything I know about hope and perseverance through their shining example.

Finishing my dissertation has required the support of many people in my life. First, I would like to thank my supervisor, Ken Craig. He has been a mentor, a colleague and a friend. I consider myself fortunate to have had such a remarkable supervisor during this formative time in my career. I would also like to thank my core committee members, Ralph Hakstian and Peter Suedfeld for their informative comments and support while I was writing up this dissertation. During graduate school, I was also a member of a vibrant and productive lab and accordingly I would like to thank my labmates (present and past): Christine Chambers, Rami Nader, Tina Wang, Liz Job, Kelly Hayton and David Wong. They were, and continue to be, such warm and supportive colleagues that I also consider them my friends.

I have also been blessed with many wonderful friends outside of academia. Throughout these years, Jennifer McFadden, Letty Katchen, Angela Vivolo, Martine Habra and Melanie Badali, have brought laughter and joy into my life and reminded me of a life that had nothing to do with clinical hours, coursework and publishing. My family has also been a wonderful source of love from which I draw strength. Special thanks go to Samson, Richard and Francis Pillai and Sharon and Neville Riddell for grounding me and helping me through the ups and downs of these years in graduate school.

Finally, my biggest debt of gratitude is owed to my husband, Steffan. Since the beginning of my Masters, he has been there to laugh with me, cry with me and dream with me. Our love has become the foundation of all that I do.
Attributions of Pain to Infants:
A Comparative Analysis of Parents, Nurses and
Paediatricians

Introduction

The premise that infants are insensitive to pain was widely accepted until quite recently (Anand & Hickey, 1987). Their presumed state of physiological and cognitive development (McGraw, 1943) seemed to justify subjecting infants to painful and invasive procedures without benefit of analgesic or anaesthetic care. At one time, open heart surgery was considered less dangerous to an infant than a scheduled dose of morphine (Swafford & Allen, 1967). As a new era of infant pain research unfolded, researchers and clinicians generally relaxed archaic notions that the infant was impervious to pain, although there are still vestiges of the outmoded belief (Vertosick, 2000). With growing recognition of the reality of pain during infancy, questions regarding infant pain experience shifted from ‘if they experience pain’ to ‘how do they experience pain’.

The International Association for the Study of Pain’s definition of pain (1994; 2003) promulgates the position that pain is most definitively a “subjective” experience. Pain advocates the world over also state that “pain is what the patient says it is” (Agency for Health Care & Policy Research, 1992). However, the question of how to assess and consequently manage pain in patients who cannot speak arises (Anand & Craig, 1996). Deciphering the pain experience of an infant is a challenging endeavour, as adults do not have direct access to the subjective experience of an infant via self-report. The limited ability of an infant to communicate their pain and to moderate their pain experience
places great importance on caregivers in accurately detecting when they are suffering (Craig, Gilbert-MacCleod & Lilley, 2000).

The research that has been conducted in the area of infant pain judgment has been critiqued as lacking a basis in an overall theoretical model and using unrepresentative samples (Ladner, 1990; Abu-Saad & Hamers, 1997; Di Giulio & Crow, 1997). Furthermore, despite the research increasingly available, infant pain has still remained inadequately treated. Early work focused on fine-grained and specific aspects of infant pain assessment (e.g. was a cue, such as facial activity, important to pain judgments?), with little attention addressing broad theoretical issues regarding how a judge was making pain ratings. Furthermore, the preponderance of infant judgment research has been conducted with nurses as subjects. Little is known about how these findings generalize to other caregivers crucial in the care of infants, such as parents and paediatricians. Parents, nurses and paediatricians all play integral roles in the care of infant pain. However they differ in many respects, such as their relationship to the infants, the amount of time they spend with an infant, the quality of time spent with an infant and their level of formal health care training. These differences warrant further study as other influences on pain judgments.

The purpose of this study was to conduct a comparative analysis of infant pain attributions and the beliefs that were integral to those attributions across three different groups of caregivers. Craig’s (2002) Sociocommunication Model of Infant Pain provided a conceptual framework in which to investigate these findings (see also Craig, Korol & Pillai, 2002). Because infants are unable to report pain and they have a limited ability to self-modulate their pain, better understanding of the attribution of pain to the infant is an
important area of research. The current research project examined through a quasi-experimental design how different groups of caregivers attributed pain to infants. Separate samples of parents, nurses and paediatricians were recruited from the community to participate in a judgment study. Participants provided demographic information and their general beliefs about pain in infancy. Then they viewed video clips of infants’ reactions to an immunization injection and subsequently provided judgments regarding sensory and affective dimensions of the infants’ pain. Every judge viewed infants belonging to five age categories: 2 months, 4 months, 6 months, 12 months and 18 months. Finally, after completing judgments of all infants in a particular age group, participants filled in questionnaires designed to elucidate how they made their pain attributions.

In summary, this series of studies provides a quantitative, comparative analysis of infant pain attributions across three different caregiver populations (parent, nurse and paediatrician). By working towards a better pragmatic and conceptual understanding of how caregivers attribute pain to an infant, it is desired that a valuable contribution will be made to the theoretical framework surrounding infant pain assessment and that these findings will translate into a reduction of the amount of pain experienced during the formative period of infancy.
Literature Review

Evolving Conceptualizations of Pain in Infancy

A definition of pain promulgated by the International Association for the Study of Pain (IASP Task Force on Taxonomy, 1994) characterized it 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. Each individual learns the application of the word through experiences related to injuries in early life”. Although this statement was intended to be universally applicable, this definition was recently modified due to the vociferous arguments of researchers appalled at the emphasis on self-report and implications of this definition for vulnerable populations, such as infants (Anand & Craig, 1996). A subsequent addendum clarified this definition by noting that “the inability to communicate verbally in no way negates the possibility that an individual is experiencing pain and is in need of appropriate pain relieving treatment” (IASP Task Force on Taxonomy, 2003). As the Latin root infans (incapable of speech) denotes, infants are unable to “describe” their pain sensations due to developmental considerations. Furthermore, due to their tender age, they have limited “experiences” outside the womb. Researchers argued that without this recent modification, the IASP definition codifies a dismissive attitude towards all nonverbal populations’ experiences of pain.

Controversy over the conceptualisation of pain in the neonate is not a new phenomenon. Early studies suggested that infants did not possess a cortex well developed enough to perceive or localize pain (McGraw, 1943). Anand and Hickey (1987) reported that many scientists erroneously believed that because myelinization of
nocioceptive afferent fibres was not completed at birth, pain transmission was impossible. Other clinicians and researchers denied the ability of infants to experience pain for reasons such as the inability of infants to verbally report pain experiences, the inability for adults or children to remember their own infant pain experiences, and the developmental immaturity of their nervous systems (Field, 1995). These assertions do not withstand scrutiny.

Derbyshire (1996, 1999) combines physiological and cognitive perspectives to deny pain experience in an infant until roughly one year of age. As a foundation for this bold assertion he cites Leventhal's (Leventhal, 1984; Leventhal & Scherer, 1987) cognitive model of the parallel processing of pain. This model postulates that emotional, informational and sensory dimensions of the pain experience are processed separately but concurrently when one is exposed to a noxious experience. These authors concluded an infant is unable to experience pain until they have had enough experience with pain to develop the cognitive structures necessary to process the emotional and informational dimensions of the pain experience. They further argue that only through past pain experiences can an infant develop emotional and informational processing structures to the point at which said infant can be considered to be experiencing pain. Until these structures are formed, Derbyshire considers infant responses to noxious stimuli as simply elementary nocioception (reflexive biological reactions to noxious stimuli) and not pain. In essence this group collectively has posited a circular conundrum; to experience pain one must experience pain.

Due to systematic biases of this type entrenched within the medical system, infant pain was largely ignored in professional and scientific literatures until the past two
decades. Fortunately, in recent times, work has been completed undeniably attesting to the fact that infants have the anatomical and functional requirements to perceive pain (e.g. Anand, 1987, Fitzgerald, 1991) and respond behaviourally during tissue insult in a manner unequivocally interpretable as pain (e.g. Grunau & Craig, 1987). As researchers and clinicians began to accept the reality of pain in the infant, research began exploring the behavioural manifestations of infant pain, ascertaining the state of care of infant pain, and exploring the impact of unrelieved pain during infancy.

Decoding Pain in Infancy

The slowly developing language ability of infants limits access to their subjective interpretation of a noxious experience (Bozette, 1993). Franck & Miaskowski (1997) summarised additional obstacles to assessing infant pain as follows: a) lack of specificity of sensory and motor reaction to both painful and nonpainful procedures due to developmental immaturity; b) possible habituation of neonatal behavioural and physiological responses to stimuli; and c) rapid maturation of the central nervous system making it difficult to make comparisons of pain responses to infants that differ in age by only a few weeks. These challenges to infant-caregiver communication require that a diligent caregiver should attend to signals aside from verbal report to determine whether palliative efforts are necessary or, if already engaged in the pain management process, to establish if these strategies were working (Craig, Korol & Pillai, 2002).

With the care of infants in pain, it is important that one recognise the independence of the terms “verbal” and “communication” and acknowledge the validity of nonverbal modalities of pain communication. Infants are capable of many nonverbal
signals that communicate they are in pain (Hadjistavropoulos, Craig, Grunau & Johnston, 1994; Slevin, Daly & Murphy, 1998; Craig, Korol & Pillai, 2002).

Physiological Indices of Infant Pain

Physiological activity. The physiological stress associated with invasive procedures is reflected in an array of objective changes. Biochemical assays taken via blood or salivary samples indicate that cortisol and catecholamine levels increase in a graded manner with increasingly invasive stimuli (Gunnar, 1989). Vital signs such as heart rate, respiratory rate, blood pressure, palmar sweating and oxygenation levels also change in response to noxious stimuli; however, research concerning consistent patterns during different infant states and developmental stages is still ongoing (Whitfield & Grunau, 2000). Promising work with vagal tone suggest that this index may provide an accurate and reliable measure of the neonatal stress response to pain (Franck & Miaskowski, 1997). Vagal tone “employs a time series signal processing technique to measure the variation in heart period pattern occurring within the frequency band associated with spontaneous respiration and is believed to specifically reflect parasympathetic influence on heart rate” (p. 361, Franck & Miaskowski, 1997). The main benefit of this measure is that it appears to be sensitive to differences in stimulus intensity. This characteristic suggests the future potential of providing an objective index of infant pain that has increased specificity and sensitivity over the other physiological indices.

Although physiological measures are seen as sensitive indicators to stressful procedures, not all stress is painful. Changes in heart rate, respiratory rate, blood pressure, oxygen saturation, vagal tone, palmar sweating, plasma or salivary
catecholamines and cortisol also are instigated by non-painful aversive events and non-aversive events. As well, these physiological indicators appear to diminish or habituate with time even though pain may persist. Hence, caution is needed in interpreting either physiological arousal as indicative of pain, or its absence as indicative of an absence of pain. Another caveat that must be exercised concerns generalizing between pre-term and full-term infants. Johnston & Stevens (1996) found that 32-week old premature infants demonstrated greater physiological changes (heart rate, oxygen saturation) than the later born infants when undergoing a heel lancing. Notably, clinicians have asserted that with newborn and premature infants physiological signs were more relevant (Purcell-Jones, Dormon & Sumner, 1988; McLaughlin, Hull, Edwards et al., 1993) than with older infants.

One benefit of including physiological measures when assessing an infant’s pain is that they are relatively easy to obtain, as most tertiary care nurseries routinely monitor vital signs. This must be counterbalanced with the increased cost of utilising expensive monitoring equipment, the lack of specificity of these responses to pain and the phenomenon of habituation when pain is ongoing, such as in postoperative pain (Pigeon, McGrath, Lawrence et al., 1989; Craig, Whitfield, Grunau et al., 1993; Schade, Joyce, Gerkensmeyer et al., 1996).

**Behavioural Indices of Infant Pain**

Continuing evidence suggests that behavioural measures consistently differentiate responses to noxious and innocuous stimuli, while being more readily accessible to caregivers than physiological measures. These facts contribute to the belief that behavioural measures have a greater utility in assisting caretakers to identify pain than
physiological measures (Agency for Health Care and Policy Research, 1992; Hamers, Abu-Saad, Halfens et al., 1994; Hudson-Barr, Duffey, Holditch-Davis et al., 1998). Franck (1987) surveyed 76 neonatal intensive care nursing units and asked them which clinical signs were most commonly used to assess pain. The vast majority of respondents listed behavioural indices such as ‘cry’ and ‘activity’ as their top two indicators despite being able to select from an exhaustive list of physiological and behavioural indicators. The categories of ‘cry’ and ‘activity’ are notably non-specific, suggesting the possibility that in reality the nurses actually use other more specific cues.

**Facial Expression:** Franck, Greenberg & Stevens (2000) state that “facial expression has been the most comprehensively studied behavioural pain assessment measure. It is the most reliable and consistent indicator of pain across populations and types and as such, should be considered the gold standard of behavioural responses for pain in infants” (p. 493). This is consistent with the face’s capacity to display a remarkable diversity of patterns within a brief span of time, reflecting varied subjective states even in the newborn (Craig, 1998). New parents recognize this and spend protracted periods of time scanning the infant’s face, endeavouring to divine an understanding of the child. Facial recognition of one’s own child appears to develop quickly. Within two days, mothers and fathers can accurately select a photograph of their own infant embedded within an array of four infants matched for race, sex and age, with mothers being able to do so with pictures masking eyes, mouth and nose (Porter, Boyle, Hardister et al., 1989). The inherent biological value of nonverbal, facial communication (Prkachin & Craig, 1995) is also reflected in the infant’s ability to seek out and perceive human faces at a very early age. Neonates are capable of imitating
facial displays and by three months of age, infants demonstrate preferential gazing patterns for facial over nonfacial stimuli (Dannemiller & Stephens, 1988).

The infant facial expression of pain is characterized by a furrowed brow, eye squeeze, deepening of the nasolabial furrow, vertical and horizontal stretched lips, and cupped tongue (Grunau & Craig, 1987; Grunau, Johnston & Craig, 1990). The cupped tongue and vertical mouth stretch in particular tend to be sensitive and specific to differentiation of the pain and no pain states (Grunau & Craig, 1987; Korol, Craig & Jenkins, 2000). Interestingly, invasive procedures provoke a relatively unique configuration of facial activity at birth in both pre-term and full-term newborns (Izard, Hembree, Dougherty & Spizziri, 1983) with this persisting throughout infancy, and proving consistent with facial activity observed in older children, adults, and seniors (Craig, Korol & Pillai, 2002). However, despite this overall consistency in the facial expression of pain across the lifespan, research has indicated that vulnerable infant populations (premature, medically compromised) tend to mount a less vigorous facial display for pain (Craig, Whitfield, Grunau et al., 1993) than healthy full-term infants when exposed to similar levels of noxious stimuli.

Johnston and Stevens (1996) addressed this difference between the facial responses of full-term and pre-term infants directly by conducting a comparative analysis examining whether the apparent deficit was due to prematurity or repetitive medical procedures. The study involved two samples of infants that were both 32 weeks post conception. One sample, however, had been born 4 days earlier while the other sample had been born 4 weeks earlier, residing in the hospital since birth (daily exposures to painful procedures). Exclusionary criteria ensured that both samples of infants had not
had major health complications (aside from prematurity). In response to a painful
stimulus (heel lancing), the earlier born infants showed significantly less facial action.
Given that it was the sample of earlier-born pre-mature infants who had been exposed to
repetitive noxious stimuli that demonstrated less facial activity, this suggested a need for
caregivers to use lower thresholds of facial reactivity with these younger infants.

Systematic measures of facial activity during pain, such as the Neonatal Facial
Coding System (NFCS; Grunau & Craig, 1987) and the Maximally Discriminative Facial
Coding System (MAX; Izard, 1979), have become well-known measures for establishing
the presence of pain in infants. The NFCS has become more widely used as it does not
require subjective judgments. Izard’s system is based on a pain face template created
from research describing combinations of brow, eyes and mouth action that display
discrete emotional expressions. Judges are given 10 different pictures of infant
expressions, with each picture representing different emotions or pain. Judges are asked
to select which picture or template best resembles the infant they are judging. Using this
system, correlational relationships were found between facial reactivity to pain and infant
temperament (Axia, Bonichini & Benini, 1999). NFCS is a sensitive and specific
measure of pain in infants (Grunau & Craig, 1987), adapted from the Facial Action
Coding System (Ekman & Friesen, 1978). The following discrete facial actions are
scored in terms of presence or absence: brow bulge, eye squeeze, naso-labial furrow,
open lips, vertical stretch mouth, horizontal stretch mouth, lip purse, taut tongue, tongue
protrusion and chin quiver. Many argue that NFCS is a more valid measure of the facial
display of pain, as it does not depend on a unitary template for pain expression as does
the MAX system (e.g. Johnston, 1989) and it is less dependent upon the judges’
subjective judgments. Furthermore while both these systems have been criticized for being time consuming and therefore limited in clinical utility, recent work in clinical settings with less labour intensive versions of NFCS has shown high levels of reliability, construct validity and concurrent validity (Grunau, Oberlander, Holsti et al., 1998; Pereira, Guinsburg, de Almeida et al., 1999).

**Body Movement:** Perhaps less complicated than ascertaining discrete facial actions, the simplest of behavioural reactions to painful stimuli would be reflexive withdrawal, a reaction observable in nonhuman species and describable in terms of spinal reflexes (Fitzgerald & Andrews, 1998). The flexion reflex is a classic response to painful stimulation applied to the foot or lower limb that has been demonstrated in infants as young as 27 weeks (Field, 1995). Franck (1986) has demonstrated that the latency of the withdrawal reflex could be quantified and considered akin to perceived pain threshold in adults. Pre-term infants have demonstrated a lower threshold for the withdrawal reflex, suggesting a hypersensitivity to pain until 32 weeks post conception age (Fitzgerald, 1991; Fitzgerald, 1997).

The Infant Body Coding System (IBCS; Craig, McMahon, Morrison et al, 1984) examines multiple areas of infant body reactivity. In addition to measuring the occurrence of vocal actions, the IBCS measures general facial, torso and limb activity. Pain in infants has been associated with limb guarding, limbs flailing, curling and/or grasped hands, arched neck, bent back, and rigid torso. While these global patterns of body activity signify distress, the behaviour tends to be relatively indiscriminate, with observers not able to derive much information from the behaviour to clearly identify the source of distress as pain (Craig, Whitfield, Grunau et al., 1993) or even the intensity of
distress (Franck & Miaskowski, 1997). The body movements of pre-term infants appear to be less vigorous when compared to full-term infants receiving similar noxious stimulation (Craig, Whitfield, Grunau et al, 1993). This reduced responding is hypothesized to be due to limited energy available to maintain a vigorous body response as these premature infants are using their metabolic resources primarily to maintain their precarious survival.

**Infant Cry:** Cry can be considered not only a vocalisation, but also an expression of emotion and the behavioural state of the infant (Wolfe, 1969). After exposure to noxious stimuli, an infant’s short latency to cry and the cry reaction in itself has been widely replicated (Porter, Porges & Marshall, 1988; Franck & Miaskowski, 1997; Craig, Gilbert & Lilley, 2000). Craig, McMahon, Morison & Zaskow (1984) noted that across the most common reactions to a needle stick, crying was the most salient and frequently occurring reaction. Their observational study revealed no sex differences in cry vocalisations and they found that the older the child the shorter the duration of the cry.

When summarising the relationship between cry and pain, Fuller (2001) succinctly stated that despite the use of different pain cry and control paradigms, studies have found certain convergent results. Cries elicited by the application of a painful stimulus were higher pitched, louder, harsher, had greater spectral energy in the higher frequencies and were more irregular both acoustically and temporally. Recent work by Fuller (2001) indicated that while cry pitch can indicate that pain is present, it does not reliably reflect the intensity of the pain stimuli. Others take issue with this point stating that it is not the objective intensity of pain stimuli that should be related but rather the
severity of infant distress and that is reliably encoded in cry (Craig, Gilbert-MacLeod & Lilley, 2000).

Franck & Miaskowski (1997) also noted that reliable characteristics of an infant’s pain cry were latency to cry and increased crying time with shorter cry cycles. Duration of cry has been also found to be a useful measure of analgesia (Taddio, Nulman, Goldbach et al, 1994; Blass & Shah, 1995).

Johnston, Stevens, Craig et al. (1993) found that the aforementioned pain cry characteristics generalized to premature, neonatal, two months old and four months old infants, with one exception. Notably, premature infant pain cries tended to be of a much higher pitch.

The almost universal reaction of distress that a caregiver experiences when confronted with a crying child speaks to inherent communicative properties of infant cry (Murray, 1979). However, while the infant pain cry is generally sensitive to painful events, it lacks specificity to situations in which the infant is experiencing pain. As aforementioned, stress does not have to be painful. As an infant is noted to cry in situations of both painful and nonpainful distress, the utility of cry as a reliable specific indicator of pain in neonates is limited (Johnston, 1989; Barr, Hopkins & Green, 2000; Gustafson, Wood and Green, 2000). This has led other cry researchers to assert that an infant’s cry does not offer specific information about an infant’s pain per se but rather offers information about the intensity of the distress (Craig, Gilbert-MacLeod & Lilley, 2000). From a bio-evolutionary perspective, should an infant have a specific cry for pain, it would be logical that caregivers would demonstrate an innate ability to discern the reason for the cry. Gustafson, Wood and Green (2000) summarised numerous studies
demonstrating that even experienced caregivers are unable to reliably distinguish between different infant cries. Thus, in agreement with Fuller (2001), they postulate that infant crying better fits the paradigm of a "graded signal" whereby varying intensities of infant cry denote degree of urgency rather than specific cry vocalisations for pain, hunger, boredom, etc.

Regardless of whether one believes that there is a specific pain cry or that cry denotes a level of the infant's distress, it is important to note that the absence of cry does not automatically denote the absence of pain (Franck & Miaskowski, 1997). This is vividly demonstrated in the case of intubated infants and other infants who are medically compromised and unable to (have limited ability to) cry with the same vigour as full-term infants (Stevens, Johnston and Horton, 1994).

Changes in infant state: Altered behavioural states have been noted in the majority of infants undergoing painful stimuli (Field, 1995). Behavioural states can be described as a cluster of discrete behavioural and physiological elements representing the qualitative variations in infant arousal (Franck & Miaskowski, 1997). More concretely, Prechtl (1974) defined four categories of sleep-awake states in infants: quiet sleep, active sleep, drowsiness and awake. Painful stimuli have been shown to evoke measurable changes in infants' regular sleep-wake cycles (Anand & Hickey, 1987). For example, increased periods of wakefulness and longer periods of non-rapid-eye-movement sleep (resulting in less rapid-eye-movement sleep) have been noted in newborns following circumcision (Emde, Harmon, Metcalf et al., 1971). In hospitals, behavioural state changes are generally measured either via subjective assessments (of researchers or clinicians) or sophisticated apparatus. This equipment is utilised to measure indicators of
state such as respiratory levels, eye movements and brain activity. Whether one is utilising a physiological or behavioural measure of pain response in infants, it is crucial to factor infant state into the analysis as baseline behavioural state influences neonatal responsiveness to all environmental stimuli (Korner, 1972; Grunau & Craig, 1987; Bozette, 1993). Reflecting this point, numerous multidimensional measures of pain include measures of state as one of their key indices (Krechel & Bildner, 1995; Stevens, Johnston, Petryshen et al., 1996; Ambuel, Hamlett, Marx et al., 1992). Note again, however, that while behavioural state is sensitive to pain, it is not a specific index.

Thus, although behavioural indicators such as facial activity and body movement have been shown to be sensitive and, in some cases, specific to pain in infants as young as 25 weeks (Craig, Whitfield, Grunau et al., 1993), an overall understanding of different behavioural and physiological indicators of pain still leads many to assert that the assessment of infant pain should be multidimensional, as no unitary measurement captures the phenomena of infant pain completely (Johnston, 1989; American Academy of Pediatrics and American Pain Society, 2001). However, an undisputable combination of behavioural and physiological indicators to be included in a given multidimensional measurement has yet to be determined.

**Current state of infant care in hospitals**

At least in part due to the difficulties of ascertaining the presence and intensity of infant pain, it is often the case that infant pain is undermanaged. However, current research indicates that the quality of infant pain management, although coming from a history of incredible levels of neglect, is improving.
Until the eighties, surgical procedures were routinely performed on infants who were administered a paralytic drug but no form of anaesthesia or analgesia (Swafford & Allen, 1968; Lippmann, Emmanouilides et al, 1976; Scanlon, 1985), due to a denial of pain in infants. By the late 1980's, medical advances contributed to increased survival rates of infants at younger and younger pre-term ages. As a result, interest in the pain management of hospitalised infants rapidly increased (Stevens, Gibbins and Franck, 2000). Franck’s (1987) survey of neonatal nurses indicated that pain medication was beginning to be routinely used during the post-operative period, but analgesic pain relief was not used for the tissue damage inflicted by procedures such as central line placement or chest tube insertions. The majority of nurses reported that when a paralytic agent was given to an infant, neither analgesics or sedatives were given routinely to treat pain or agitation. Overall, 79% of nurses surveyed believed that pain medication was underused. This was underscored by their “frequency ratings of pain interventions utilised”, which indicated that medication was ranked after such strategies as administering a pacifier, position changing, and holding the infant. Given the objective pain intensity of procedures such as chest tube insertions and central line placements these non-pharmacological palliative strategies were deemed by the author as inadequate. Ten years later, Porter, Wolf, Gold et al (1997) conducted a survey of nurse and physician beliefs. Once again, the preponderance of nurses and physicians indicated that pharmacological and non-pharmacological strategies were being underutilized, resulting in significant levels of unrelieved pain.

Elander, Hellström and Qvarnström (1993) went beyond eliciting opinions to determining how infant pain management was actualized. Infants in a hospital’s
Neonatal Intensive Care Unit (NICU) were observed for 24 hours postoperatively following major surgery. Various pain behaviours (vocalisations, facial activity, sleep-awake states) were monitored in addition to analgesic medication administered and non-pharmacological strategies utilized. They concluded that pain management for these infants was generally inadequate, inconsistent and poorly co-ordinated. They further highlighted the fact that injections of analgesia were given to these infants (an additional source of pain) unnecessarily as IV access was available in all cases.

Lack of training in infant pain assessment and management could be one predominant cause of the mismanagement of infant pain. A cross-section of American health care providers was surveyed about their paediatric pain training and practices (Broome, Richstmeier, Maikler et al., 1996). Results suggested that while the slim majority of institutions surveyed had standards of care or protocols for pain management, fewer than half of these institutions followed these standards regularly. Seventy-three percent of the nurse respondents indicated they received formal training concerning pain management while only 17% of physician respondents had received any formal training in pain management. Eighty-three percent of the combined sample of health professionals indicated that the largest obstacle to optimal pain management was “knowledge deficits”. When asked specifically about their perceptions of the relative effectiveness of the assessment and management of infant pain (when compared to older children and adolescents), the sample indicated that both pain assessment and treatment were significantly less effective during infancy.

Signs of improvement in the status of care of hospitalized infants were seen in a Canadian study by Johnston, Collinge, Henderson and colleagues (1997). Fourteen
NICU's participated in a 24 hour study period. Daily logs were kept of the frequency and type of procedures and analgesia administration for all neonates. While this sample only represented one-third of the NICUs in Canada, initial analysis indicated that the 'participant' and 'non-participant' hospitals did not differ on number of beds, number of admissions, number of surgeries and number of university affiliates. In total, 2,134 invasive procedures were performed on the 239 infants monitored during the study period. Ninety-nine percent of the invasive procedures fell into the following categories (in order of decreasing frequency): heelsticks, intravenous starts, venipuncture, arterial puncture, endotracheal intubation, umbilical catheterization and lumbar puncture.

Results indicated that post-operative pain was being treated well and that the vast majority of infants were receiving pain medication for invasive procedures, such as arterial line insertions and urinary bladder catheterizations. However, for other less-invasive procedures such as intravenous starts, heel sticks, and venipuncture, a very low proportion of infants received pain medication (average percentage over all invasive procedures was 6.8%). The authors noted that while these lesser invasive procedures were often not treated for pain in adult populations, the repeated painful procedures in these infants most likely resulted in iatrogenic effects such as allodynia and hyperalgesia, thus increasing the level of pain intensity for subsequent procedures (also Andrews & Fitzgerald, 1994; McIntosh, 1997) and magnifying the need for pain management.

Furthermore, the contextual factors in which hospitalized neonates experience these repeated procedures (e.g. bright environment, whirring machines, reduced contact with a primary caregiver) most certainly impacts the level of pain they experience and their pain
response when compared to adults undergoing similar procedures (Field, 1995; Johnston & Stevens, 1996).

It is important to note that since the late eighties, the vast majority of studies have reported that health professionals recognize the need for improvement in the care of pain throughout infancy. Inherent in this reported divergence between ideal standards of pain relief and routine practices of pain relief is basic recognition that infants experience pain. This appreciation of the realities of infant pain by health professionals demonstrates substantial progress towards optimal infant pain management (McIntosh, 1997; Stevens & Koren, 1998). However, despite the improving recognition and management of infant pain, substantial amounts of infant pain still go unrelieved. Researchers from both basic and behavioural sciences are now ascertaining the enduring impact of unrelieved pain in the infant.

Longer-term consequences of unrelieved infant pain

With the advent of NICU’s and progressively more advanced medical care in the seventies (Whitfield & Grunau, 2000), increasing survival rates of infants at younger and younger post conception ages have placed upon society new challenges regarding the impact of painful procedures on these vulnerable infants as they develop towards childhood and adulthood.

Physiological Sequelae

The newborn infant, regardless of prematurity status, is engaged in the progression towards maturing nervous and endocrine systems. The plasticity of these systems within the developing infant means that exposure to extensive or repetitive trauma (physical or otherwise) carries with it an increased risk of altering the final
developmental endpoint of that individual in adulthood (Winberg, 1998). The short term impact is clear. Post-operative pain in the neonate has been shown to impact respiratory function via tachypnoea, reduced coughing and uncoordinated respiratory effort (Purcell-Jones, Dormon and Sumner, 1988) and, as previously reviewed, behavioural indicators of pain and distress such as cry, facial activity, body movements etc. Other work with pre-term infants (27-32 weeks) demonstrated that repeated routine heel sticks resulted in these infants having a lower threshold for tactile stimulation for subsequent days and weeks (Fitzgerald, Millard and McIntosh, 1989). However, it is more difficult to experimentally examine longer-term implications of pain.

Due to the aversive nature of repetitive data collection with infants (e.g. multiple heelsticks to obtain blood samples), it is recognized as unethical to engage in experimental manipulations in humans. Thus, much of the work accomplished understanding the developmental trajectory of pain systems has been done with rat pups due to their accepted suitability as a model for human infants (Fitzgerald, 1997).

Fitzgerald (1997) noted that exposure to painful stimuli during critical periods of nervous system development results in structural and functional reorganization that permanently alters the final adult pattern of connections. For example, if a cutaneous sensory axon were damaged during a critical period of development, it would be cut off from trophic support from peripheral target tissues, resulting in irreversible death of the dorsal root ganglion cells in the spinal cord. Another vivid example that was offered is that peripheral nerve injury in the neonatal rat permanently alters connections in the thalamus and the somatosensory cortex, distorting the representation of the body surface, or the somatotopic map in the brain (Reynolds & Fitzgerald, 1995).
Anand and colleagues also have been conducting complementary animal research supporting the proposition that exposure to tissue damage during the formative time of infancy impacts the way that individuals perceive pain for the rest of their lives. Overwhelming evidence suggests that the full-term neonate is more sensitive to pain (Schellinck & Anand, 1999) than adults. By exposing rat pups to different inflammatory pain paradigms (e.g. administering substances causing inflammation), and examining slices of their cortices post-mortem, Anand and colleagues have demonstrated increased neuronal cell death (apoptosis) in the cortex, hippocampus, amygdala and hypothalamus (Anand, Berde and McCormick, 2002). Given that these key brain structures are not fully developed at birth (Rosenzweig, Breedlove and Leiman, 2002), the increased level of apoptosis suggests a permanent alteration of these structures due to pain. In work attempting to emulate the most common noxious stimuli involved with a NICU stay (e.g. multiple heel sticks for blood sampling purposes), Anand (2000) exposed a sample of rat pups to one needle prick in each paw daily during the first week of their postnatal life. While the rats did not demonstrate stress-induced changes in hypothalamic-pituitary axis responsiveness, certain longer-term behavioural correlates were found. When compared to control rats, the chronically poked rats showed increased defensive withdrawal behaviour, reluctance to explore an open field, and a greater preference for alcohol. Tentative parallels were drawn, and these rat behaviours were hypothesized to possibly be related to anxiety disorders and substance abuse problems in humans.

Reviewing these animal model studies allows one to speculate about profound and permanent effects unmanaged pain would have on early nervous system development in the human infant. However, when one examines the cognitive and behavioural
sequelae of painful experiences, researchers become able to study these implications more directly.

**Behavioural and Cognitive Sequelae:**

Much work has been undertaken exploring the impact of pain on behaviours of human infants exposed to unitary and multiple exposures of noxious stimuli. The work on unitary exposures has generally been conducted with healthy full-term infants while the multiple exposure work has generally been performed with premature infants. Given the differences in pain exposure (generally repetitive versus singular) and the aforementioned differences in pain expression between these two populations, the literature regarding the longer-term impact of early pain experience may not necessarily generalize between the two. Definitive work needs to be completed to discover if full-term and premature infants experience similar long-term implications of early pain experience.

**Pre-Term Infants.** Work trying to untangle the implications of repetitive early pain is mired in confounds. Repetitive pain exposure during the hospitalization of premature infants often means that, when compared to full-term infants, these infants are less healthy, have grown in a less than optimal uterine environment, and have experienced prolonged separation from their primary caregiver after birth (Grunau, Whitfield, Petrie et al., 1994; Porter, Grunau and Anand, 1999). Thus, the relationship between pain and future behaviours has been readily asserted as having many moderating influences.

Grunau, Whitfield and Petrie (1994a) found that surviving extremely low birth weight (ELBW; less than 800 grams) children studied at the age of 18 months were rated...
by their parents as significantly less reactive to everyday pain. Parents of these children relayed to researchers that they needed to teach their ELBW children that when they were in pain they should communicate it to someone, as this skill did not independently develop. This raises questions as to whether there are deficits at the level of pain experience or expression. Grunau, Whitfield, Petrie et al. (1994b) found that ELBW infants at 4.5 years have a higher tendency to somatisize (somatic complaints with unknown origin) than children born full-term. This elevated tendency to somatisize (of ELBW infants) was hypothesized to be moderated by maternal factors such as level of sensitivity and gratification from interactions with child. Also, the child’s temperament and the child’s avoidance of touch at the age of three also distinguished between ELBW children who had clinical levels of somatization and those who did not. Specifically the more difficult the temperament and the more a child avoided touch, the more likely they were to have clinical levels of somatization. Due to the age of the children in these earlier studies (too young to reliably self-report), variables for these analyses predominantly focused on parents’ subjective perceptions and behavioural observations of their ELBW children’s temperament, touch, somatization, etc.

Grunau, Whitfield and Petrie (1996) were able to focus on more objective child-centric variables in their comparative study of 8-10 year old children who had been either ELBW or full-term infants. Both groups were presented with pictures of different pain situations across various realms (medical setting, recreation, routine activities, psychosocial situations) and asked to judge the level of pain intensity and affect experienced by the individual in the picture. ELBW children were found to attribute higher levels of pain to medical situations than full-term children. Of note is that by this
age many other confounding life events would have differentiated the two groups, thereby distorting the straightforward interpretation of this finding (e.g. medical/psychological problems directly resulting from being born premature and the impact of prematurity on socioemotional functioning, school history, etc.). However, despite this added ‘noise’, the number of days spent in the NICU was significantly correlated with reported pain affect for the pictorial stimuli.

With full-term infants, co-morbid health complications are not as conspicuous an issue.

*Full-Term Infants.* Evidence of anticipatory fear of painful stimuli at 6 months (Levy, 1960) was one of the first longer-term consequences of pain noted in the infant. More recently, Taddio, Shah, Gilbert-MacLeod et al. (2002) reported evidence that infants have the ability to anticipate pain as early as 2 days after birth. Derrickson, Neef and Cataldo (1993) reported a case study whereby they conditioned a 9-months old male infant, hospitalised for much of his life, to discriminate between painful and safe events with certain visual and auditory stimuli using an ABAB reversal design. It was hypothesised that facilitating the infant’s ability to predict the occurrence of aversive hospital procedures would lessen the negative behavioural effects of the events. In essence, the experiment allowed the infant to “know” that he was going to face a “non-invasive period” (e.g. bathing, dressing, non-physical infant attention from caregiver) or an “invasive period” (e.g. tracheal suctioning, injections, medication administration). After the initial conditioning period, the signalling procedures increased positive behaviours and decreased negative behaviours during both non-invasive and invasive caregiver events. By displaying more smiling and engagement with the caregiver or toys
in the crib, the infant was deemed as less distressed by the hospitalization experience.

While one must be cautious when positing cognitive explanations to a behavioural case study, this study could be suggestive of the presence of discriminative cognitive capabilities in a medically compromised infant. It appeared that the infant demonstrated understanding and that this understanding, however rudimentary, actually mediated the pain response in a way that has been asserted by Gate Control Theory\(^1\) with older children and adults.

A program of research undertaken by Taddio and others most clearly demonstrated the potential for long-term harm by exposing healthy infants to an intense pain stimulus. Taddio, Stevens, Craig et al. (1997) demonstrated the efficacy of a topical anaesthetic cream for the prevention of pain from circumcision. Infants who had been anaesthetized pre-emptively (before the procedure took place) for the procedure demonstrated lower levels of pain as measured by facial activity, cry duration and heart rate. Of even greater interest for understanding the long-term consequences of early pain were the results when these infants were followed up at a subsequent infant immunization (Taddio, Katz, Liersich et al, 1997) six months later. Three groups of infants were included in this analysis: uncircumcised boys, boys who were circumcised with topical anaesthetic cream and boys who were circumcised with no topical cream. These infants were matched on infant and maternal characteristics such as age, weight, temperament and number of primiparae (first-time mothers). Results indicated that on measures of

\(^1\) Current conceptualisations of pain attend to both cognitive and physical parameters of pain. This combined perspective began with work by Melzack & Wall (1965) and the publication of the Gate Control Theory of Pain. This theory postulated a gating mechanism within the spinal cord that closed in response to normal stimulation of the fast conducting "touch" nerve fibres from the body's peripheries to the brain; but opened when the slow conducting "pain" fibres transmitted a high volume and intensity of sensory signals. The gate could be closed again if these signals were countered by renewed stimulation of the large fibres or by descending inhibitory processes within the brain. By postulating that pain could be blocked in the spinal cord and by descending mechanisms originating in the brain, Gate Control Theory ushered in a new age in pain research.
facial activity, cry duration and rater pain intensity scores, the circumcised no-cream infants were significantly more reactive on all measures than the uncircumcised group. When comparing the two circumcised groups, the use of topical cream only differentiated the groups on the rater pain intensity score, suggesting that the cream only modestly attenuated the long-lasting changes in the infant’s central neural processing of painful stimuli. Thus, although using a topical cream for circumcision has an impact, not undergoing circumcision appears to be best in preventing increased responsivity to subsequent painful stimuli.

As indicated previously, the impact of severe or repetitive pain during infancy appears substantial, with the foundations for later pain experience being established at this time. Neuronal plasticity is highest during the postnatal period, thus providing a period in which the nervous system is extremely malleable in response to noxious environmental influences (Porter, Grunau and Anand, 1999). Despite significant consistencies between the experience and expression of pain through different stages of life, it is crucial to recognize the much steeper trajectory of development in pain experience and expression through infancy. These changes reflect rapid maturation of the biological substrates underlying pain, emotion, cognition, language and social relations (Craig, 2002).

Two areas of future interest appear to be in unequivocally demonstrating physiological (implicit) memories\(^2\) of painful experiences during infancy (Katz, 1997; Melzack, Coderre, Katz et al., 2001) and in ascertaining the impact of administering

\(^2\) The theory regarding physiological memories for pain postulate that sensory stimuli act on neural systems that have been modified by past noxious inputs, and the behavioural output is thus significantly influenced by the “memory” of these past noxious events held in the neural systems. Basically, the pain pathways become primed by significant experiences of pain in such a way that future pain events are experienced via sensitized pathways. This sensitization is the nervous system’s memory for pain.
powerful analgesics on nervous system development (MRC Expert Group on Fetal Pain, 2001). Regardless of the level of analysis undertaken, be it physiological, behavioural or cognitive, investigators are just beginning to determine the impact of unrelieved pain in infancy.

Review until this point has considered various aspects of an infant’s pain experience and expression. In order to bridge the discussion to caregivers of infants in pain, a framework depicting a broader conceptualization of the infant in pain will be presented.

The Sociocommunication Model of Pain

For almost a decade, Craig and colleagues (Prkachin & Craig, 1995; Craig, Lilley and Gilbert, 1996; Craig, Korol and Pillai, 2002) have worked to develop a comprehensive model of infant pain assessment and management. The Sociocommunication Model of Infant Pain (see Figure 1) delineates the phenomena of infant pain as a sequence of complex, interdependent stages. This model emphasizes interdependence of stages by depicting feedback loops (arrows in both directions) among sequential stages. This model purports that infant pain should not be viewed as strictly linear but rather as a dynamic, interactive process between child and caregiver.

Infant Pain Experience. Trying to comprehend the experience of pain in a competent older child or adult person is difficult, but through self-report an understanding can often be achieved. However given that infants are, at least early in life, incapable of speech, the task of deciphering when an infant is experiencing pain can be daunting. However, it is theorized that the biological composition of the infant (e.g. nervous system reactivity), the infant’s past experiences with pain (or lack thereof), and
the different social contexts (hospital, home, etc) in which the infant experiences the painful stimuli would all factor into their pain experience. These assumptions are based on factors shown to influence a verbal individual’s pain experience. Once an infant has been exposed to stimuli (e.g. tissue trauma) and has processed that these stimuli are noxious, the theory postulates that the next major step involves an infant’s reactions to the experience of pain or his/her pain expression.

**Pain Expression.** Healthy infants almost invariably react to tissue stress and damage with vigorous vocal and nonvocal activity, thereby providing a means for inferring their subjective state. In light of an infant’s dependency on caregivers for survival, motor programs such as cry, body movements and facial activity tend to clearly depict that the infant is distressed. As previously reviewed, physiological indicators also may indicate that an infant has experienced a noxious stimulus. Once again it is hypothesized that the social context in which an infant undergoes a pain stimulus will impact said infants’ pain expression.

**Assessment or Attribution of Pain.** During this step, infant caregivers become aware of and interpret the infant’s expression of pain. The caregiver may or may not initiate an information-gathering process that will result in clarification of whether the distress relates to pain or not. This attribution of pain is hypothesized to be impacted by the sensitivities of the caregiver, their knowledge level (of the specific child, of possible alternatives to distress, of children in general, of common pain cues or indicators, etc), their attitudes and their prior relationship to the child.

**Action Dispositions.** Once the caregiver has processed information gathered and made decisions as to whether the infant is in pain, the stage is set for action dispositions.
Figure 1. A Sociocommunicative Model of Infant Pain

(Craig, 2002)
Depending on the caregiver’s assessment of the level of pain, different pain-relieving behaviours may be enacted (cuddling, administering medication, withdrawal of an aversive stimuli) to aid the infant. Of significance were the failures to provide needed care.

Thus, the Sociocommunication Model of Infant Pain acknowledges a broader context of infant pain that involves consideration of not only an infant but also the potential caregiver. Because of their integral role in ascertaining and administering to the needs of the infant, those who care for infants in pain are also an area of study in their own right.

Research Examining Caregivers’ Attributions of Pain to Infants

Infants have suffered needlessly due to failures to recognize pain and the resultant lack of pain management (Anand & Craig, 1996; Craig, 1997; American Academy of Pediatrics and American Pain Society, 2001). Parents, nurses, and physicians all play important and distinct roles in decoding and managing infant pain. In order to improve the state of care in the infant, research must focus not only on the encoder of pain (infant) but on the decoder (caregiver) as well, and the multi-directional influence each has on the other in the context of pain judgment (Craig, Lilley and Gilbert, 1996; Craig, Korol and Pillai, 2002). Given the different roles and backgrounds of parents, paediatricians and nurses, it is integral to understand each of these groups both individually and comparatively.
Parents

Because of their biological connectedness and the commitments parental guardianship engender, parents play a unique role in the caregiving of an infant in pain. Unlike nurses and paediatricians they do so with little to no formal medical training, relying heavily on personal, familial and cultural experiences. Parents spend more time with their infant than would a nurse or paediatrician. Given the nature of the relationship and the amount of time a caregiver spends with an infant, it seems logical that increased time spent with an individual infant would facilitate a deeper understanding of the cues that their infant would use to communicate pain. This depth of understanding would be expected to be lacking in caregivers who are only exposed to their infant for brief periods of time. Although parents would have a deeper understanding of their infant in pain, when compared to nurses and paediatricians in a broader pain assessment context, they would not have the breadth of pain assessment experience that results from assessing many different infants in pain.

Despite the commonplace nature of the task, the only study found directly examining parental attributions of pain to infants was conducted by Craig, Grunau and Aquan-Assee (1988). They examined parental judgments of neonatal pain associated with a routine heel lance for a blood screening. Parents (28 mothers and 17 fathers) were shown video tapes of infants (who were not their own) and were asked to judge the sensory intensity and affective discomfort of each infant. Parent ratings were found to be significantly positively related to level of facial activity (using NFCS) and cry pitch. Furthermore, while affective distress scores were not significantly different between mothers and fathers, a difference was found in terms of perceived pain intensity. Fathers
were found to attribute a higher level of pain intensity than mothers. This difference was hypothesized to be due to the greater experience mothers have with expressions of pain in infants. As an aside, it is important to note that in judgment studies of infants (and other nonverbal populations) there is no objective or absolute standard available to conclude whether one judge versus another was more correct, accurate, etc. Conceivably, one could examine outcomes of intervening with different levels of perceived pain.

More recent work (Kankkunen, Vehvilainen-Julkunen and Pietila, 2002), with parents of older post-operative children aged 1-6 years of age, also demonstrated differences in pain beliefs held by mothers and fathers. In particular, more fathers believed that their child was capable of pretending to have pain; that their child should learn to tolerate pain; that post-operative pain is acceptable because of the benefits to a child’s health; and that pain is a normal part of a child’s life. Interestingly, work by Bielawska-Batorowicz (1996) suggested that gender does not influence non-pain perceptions of one’s own infant. One hundred and seventy two couples were sent questionnaires three months after the birth of their full-term child. Mothers and fathers made similar judgments of their infants in terms of emotionality, demands, activity level and attractiveness.

Although not examining pain judgments directly, Grunau, Whitfield and Petrie (1994) examined how parents’ ratings of their infant’s temperament related to their ratings of the infant’s pain sensitivity. This study was conducted with parents whose children had been of varying weights (extremely low birth weight to full birthweight) at birth. These infants were 18 months old at the time of the study. It was found that parental ratings of temperament (composed of items measuring beliefs about their child’s...
shyness, emotionality, sociability, and activity) were significantly positively related to parental ratings of pain sensitivity for the heavier birth weight children but that as initial birth weight diminished this relationship became weaker. One possible hypothesis for this difference postulated by the authors was the existence of another variable such as additional pain experiences in the NICU or subtle neurological immaturity that mediated the relationship between perceived infant pain sensitivity and reactivity. Furthermore, given that no measures of pain sensitivity or temperament were obtained other than those provided by the parents, the authors suggested that the significant relationship between parents’ personality attributions and pain sensitivity attributions could be providing more information about the parents than the infants.

Physicians

As was the case with parents, very little research has been conducted examining physicians’ infant pain judgments. While paediatricians often are parents themselves, in regards to their professional care of infants, they approach the infant pain context with a different background than both parents and nurses. They assess and offer recommendations for the treatment of infant pain with an extensive background of specialized medical knowledge. Furthermore, given their level of specialization in medical practice and the resultant fewer number of these professionals, paediatricians tend to spend less time with an individual infant but would see a greater number of infants in comparison to nurses and paediatricians. All these factors would seem to contribute to a unique paediatrician perspective of infant pain.

Schechter & Allen (1986) attempted to explain why adults were administered more analgesics than children while in hospital through surveying the beliefs of
physicians. All paediatricians, family practitioners and surgeons in the city of Hartford, Connecticut were asked to participate. Seventy one percent of the paediatricians, 42% of the family practitioners, and 50% of the surgeons surveyed responded. Multiple choice answers indicated that 75% of the sample did not believe that children “experience pain similar to adults” until 2 years of age, with similar ages and proportions found on questions inquiring about the appropriate age to administer narcotics or routine analgesia. In general, paediatricians appeared most accepting of the idea of pain in infancy being comparable to that of adults, and surgeons the least. The authors noted that the paediatrician sample contained the highest percentage of women and the surgeons contained the lowest. One criticism of this study is that the age groups provided for physicians to choose from were very broad (birth; birth – 1 month; 31 days -2 years; 2-5 years; 5-12 years; over 12 years) and would have provided more useful information had the categories been more specific especially in the ‘31 days – 2 years’ category. Furthermore, the use of the adjective “similar” in the question stem may have also unintentionally influenced the physician responses. Using the adjective “similar” made it difficult to determine if the physicians were interpreting the questions in a quantitative sense (i.e. the amount of pain experienced in infancy is less than adults), a qualitative sense (i.e. how an infant experiences pain is different) or a combination of both.

Comparable findings of Schechter and Allen (1986) were reported in a study conducted by Purcell-Jones, Dormon and Sumner (1988). Paediatric anaesthetists in the United Kingdom and Eire were surveyed regarding their perceptions of infant pain, with a much higher response rate (91%; 60/66). The vast majority of respondents (80%) believed that babies less than one week could “perceive pain”, with this number jumping
to 100% for infants who were older than one month. Yet, despite these beliefs, reports of prescribing patterns indicated a disregard for this pain. Eighty-nine percent of the sample reported “never” to “rarely” prescribing analgesia to newborns after major surgery, while this number fell slightly to 81% with infants up until the age of one month. Even with the oldest age group (3-12 months) only 54% of those surveyed reported that they “usually” to “always” prescribed opioids after major surgery.

A more recent survey conducted by McLaughlin, Hull, Edwards et al. (1993) found that attitudes and beliefs had changed considerably in a brief period of time. American physicians identified by the American Board of Medical Specialties as specialists in neonatal-perinatal medicine were surveyed as to their attitudes and practices. Forty-one percent (352/866) of the possible participants completed the questionnaire. In stark contrast to earlier surveys of this nature, almost all respondents indicated that even the youngest and most premature infants were able to perceive pain and thus required the use of anaesthesia in the perioperative period. However, attitudes towards the use of analgesic agents in the postoperative period were more variable, with only half the sample reporting that they “always” used analgesia during the postoperative period for minor surgery. Although these results give reason for optimism, the low response rate could mean that physicians who elected to respond to the survey were those physicians who prioritise infant pain management and accordingly have more optimal beliefs and practices than those who did not respond.

Nurses

If one were to set out a continua for caregivers considering specialized medical knowledge and experience with infants, one would likely place nurses between
paediatricians and parents. Similar to parents but obviously to a lesser extent, inpatient nurses tend to spend longer amounts of time with an infant under their professional care. Nurses also are involved in the routine care of infants (e.g. feeding, play and medical procedures) and obtain experience with an infant’s reaction in both pleasurable and distressing contexts. Also akin to parents, they are often involved in the interpretation of a physician’s order in how to best care for an infant. However, similar to paediatricians, they approach the infant pain context with a considerable amount of medical knowledge and training. They also see a greater variety of children than would a parent, but typically less than a paediatrician would. Unlike the literature on parent and paediatrician judgments, the preponderance of work specifically addressing how infant pain judgments are made has been completed with nursing samples. Given the strong foundation of research in this area, research addressing how nurses’ pain judgments are made will be presented later in the section addressing “Clinical Decision Making”. This present section will address research covering only nurses’ attitudes and beliefs about infant pain.

Recognising that much research conducted on nurses is done at university-affiliated hospitals, Caty, Tourigny and Koren (1995) surveyed nurses in community hospitals in north-eastern Ontario. Results indicated that as a whole, these nurses were unaware of considerable current paediatric pain knowledge. Many stated that an infant who did not mount a vigorous behavioural response to post-operative pain, an objectively noxious stimulus (surgery), was not experiencing pain. Another example of this weak knowledge base was that only 36% of the nurses described pain as subjective experience, while others tended to view pain as purely an objective physiological consequence. Lack of training in pain management was seen as a contributing factor, as only 21% of the
sample reported ever having training in pain management. Given the response rate for this study (51%), these findings may very well represent an overestimation of the knowledge base of nurses in non-university affiliated hospitals, as nurses who opted to participate may be more aware or invested in the issues in infant pain management.

Positive relationships between nursing education and pain accepting beliefs, and between nursing education and appropriate practice was directly found in a survey study completed by Margolus, Hudson & Michel (1995). In addition, years of nursing experience and age were not related to appropriate pain beliefs and practice. This suggests the importance of providing pain education to nurses regardless of the stage in their career, as education was found important regardless of nurses’ age/experience level. Although collecting a substantial sample size (228 nurses; 68% response rate), one complication of interpreting these results is that the nurses who completed this survey answered questions in regards to paediatric nurses as a whole rather than their personal beliefs and practices. Thus, these results may indicate standards of pain management they hoped to attain, rather than their actual beliefs and practices.

Salanterä (1999) conducted a survey study with 303 nurses from all five university hospitals in Finland, representing a response rate of 87%. While the survey covered general topics of pain in children, certain questions were particularly geared to eliciting beliefs about infant pain. In terms of overall beliefs about infant pain, 73% of nurses surveyed completely disagreed with a statement suggesting that children under 2 years of age feel less pain than children over 2 years. However a significant proportion of respondents expressed ‘some’ to ‘complete’ agreement with statements such as children who are sleeping could not be in severe pain and calm children who express
they are in pain are likely to be malingering. Thus, one must question the value of having the sample equate infant pain to child pain when such beliefs about older children are held. Signs of progress were seen when nurses were asked about long-term impact of painful procedures. Roughly 85% of the sample believed that children aged 6-12 months would have some form of lasting memory of recurrent painful procedures. It was indicated that overall, Finnish nurses had positive attitudes and constructive beliefs regarding children in pain; however, as a group, they lacked confidence about how to provide quality care to control pain.

Comparative Work Between Parents, Physicians and Nurses

Two studies have examined both physician and nurse behaviours and attitudes towards neonatal pain (Broome, Richtsmeier, Maikler et al., 1996; Porter, Wolf, Gold et al., 1997), one study compared both physician and parent attitudes (Woodin, Rodewald, Humiston et al., 1995) and one study analyzed all three groups in the detection of the facial display of pain (Balda, Guinsburg, Branco de Almeida, et al., 2000). These studies demonstrated the evolution in beliefs similar to the aforementioned studies on single populations. They demonstrated that, despite a widespread acknowledgement of infant pain, these beliefs were still at odds with practice. Unfortunately, Broome, Richtsmeier, Maikler et al. (1996) and Balda et al. (2000) presented data averaged over both groups of health professionals; thus, between-sample (health professional) comparisons were not presented. Porter, Wolf, Gold et al., (1997) found generally similar beliefs and reports of pain management strategies in the nurses and physicians. One interesting divergence was the impact of personal pain experience on pain ratings of common medical procedures. Physicians’, but not nurses’, pain ratings were positively related to personal reports of
having had a significant pain experience. Researchers indicated more research needed to be done before drawing any inferences from this finding, as an earlier published study with nurses did not find a link between personal medical history and judgments of pain (Page & Halvorson, 1991).

Woodin, Rodewald, Humiston et al. (1995) found an unexpected divergence in beliefs held by parents and physicians. Two hundred and fifteen physicians (82% response rate) filled out a questionnaire and 197 parents were interviewed (no parents that were approached refused participation) regarding their concerns about the practice of administering multiple infant immunization injections in one appointment (as opposed to over a series of appointments). While the most frequently expressed concern by both physicians and parents was pain, more practicing physicians than parents voiced strong concerns about young infants receiving three injections in one sitting. Under the proviso that their physician approved, the majority of parents preferred one visit rather than two visits to administer up to four injections to their child. This suggests that despite personal concerns about inflicted pain levels on their child, many parents would be willing to proceed with a more painful immunization protocol because their physician said it was okay. This finding underscores the great impact health professionals have on infant pain management by parents. This also may be evidence of the parental bias that the short-term pragmatics of having to make only one doctor’s visit outweighs the short-term pain inflicted on their infant, as the infant will not be adversely affected in the long-term (bad memories; increased pain later on, etc.).

Balda et al. (2000) conducted a study indicating that a sample of health professionals (nurses, doctors, residents and nurses’ aids) was less able to correctly
discriminate between pain and non-pain faces of an infant than parents. When presented with 3 sets of photographic discrimination tasks (i.e. correctly select the pain face among the array), parents outperformed health professionals on 2 of the 3 sets. The first set had no significant differences between the groups. When attempting to explain these differences, the authors found that the health professionals tended to be single and did not have children. They also observed that the health care workers who tended to make the greatest number of errors were the most educated. The authors noted that their findings add credence to the previously suggested relationship between knowledge and pain judgments in that greater theoretical knowledge and professional experience was linked with a greater chance to underestimate pain. However it is important to note that in their sample, greater education also translated into less direct time spent with an infant (e.g. a doctor versus a nurse) and this could be a possible alternative explanation. They went on to speculate that greater professional experience also resulted in greater exposure to issues of death, pain and malformations, thus to maintain their “psychological integrity”, professionals are less perceptive of infant pain.

As mentioned before, most work on clinical decision-making in judgments of pain in infants has been done solely with nurses as study participants. Given this narrow focus, an overview of a related literature will be provided. Within the social perception literature is a specialized area of study dedicated to how adults attribute emotions to infants. Noting the similarity of attributing emotions to infants (making a judgment of an infant’s experience based on an interpretation of cues), this literature was considered germane to the topic addressed by this work. Subsequently a review of factors that are involved when nurses make attributions of pain to infants will be presented, followed by
a discussion of existing theories in pain decision-making and then the overview of the proposed study.

Social Perception: Adult Judgments of Infants

Boukydis (1981) reviewed data on adult perceptions of infant appearance, focusing in on the attractiveness literature. He noted that current infant researchers emphasized the importance of infant characteristics and behaviours on caretaker behaviours. The first to hypothesize such a relationship was the famous ethnologist Konrad Lorenz who stated that “particular features which distinguish infants from adults are releasers of caregiver approach and nurturing behaviour”. Boukydis concluded that the attractiveness of infants alongside with behavioural expressiveness were partial predictors of caregiving attention. While noting that there was a great need for more reliable data on the nature of the impact of infant attractiveness and behavioural patterns, he further speculated that both an attractive infant (e.g. plump body, soft skin, large eyes and a high forehead) and/or an infant whom caregivers consider highly engaging (low crying rate, bright smiles, calm dispositions) would be likely to elicit caregiving behaviours.

Focusing in on the area of emotional attributions to infants, Emde, Izard, Hebner, Sorce and Klinnert (1985) conducted a laboratory study comparing adult judgments of infant emotions. The study involved correlated emotion judgments between a sample of female undergraduate students and a sample comprised of females who self-identified as being “experienced with children”. Still photos of infants during an immunization at a public health clinic and during standardized home sessions with infants (e.g. infant at rest, infant at play) were shown to the subjects. All environmental cues were removed
from the pictures and judges were given no background information about the photos. The emotions portrayed in the pictures were designated by having the expression of the infant in the picture resemble criteria set out by a facial coding system (MAX). Participants were presented with sets of stimulus pictures of infants portraying different infant emotions. For each picture they were asked to report "the strongest and clearest feeling that the baby is expressing". Results were compared to a lexicon of emotion-related words previously developed by the authors and coded into one of 10 categories (interest, joy, surprise, distress-sadness, anger, disgust, fear, shame, bored-sleepy and no emotion). The results of this study provided evidence that untrained judges, regardless of experience with children, can agree to a great extent. Positive emotion labels (joy, interest and surprise) demonstrated the highest judgment consistency (.84 to .99), while only one of the negative emotion categories demonstrated this high consistency: distress-sadness. The researchers did not provide direct accuracy data comparing the participants' emotion labels to the emotions categories determined by the facial coding system. Rather, they noted that the external validity of the decoding judgments was reflected in the high levels of agreement across judges. It was suggested that in the real world, common social experiences with infants tend to be more positively toned, thus accounting for the high agreement of judges' use of positive emotional labels. The investigators drew upon basic evolutionary theory to explain the reliability of the distress-sadness pictures. Citing Darwin's 1872 seminal work, *The Expression of Emotions in Man and Animals*, they asserted that, when identifying infant affect, judges would be most adept at identifying distress-sadness because of the survival value of a caregiver being able to correctly interpret distress. Although not discussing pain *per se*, the
distress-sadness photos were based on stills taken from an immunization scenario. It is especially noteworthy for the current analyses that adult judges demonstrated extremely high reliability with their attributions of infant distress without any background information given.

Camras, Sullivan and Michel (1993) more directly investigated adult judgments of facial, vocal and body actions involved with negatively-valenced emotions. The researchers were particularly interested in whether or not judges, as predicted by differential emotion theorists\(^3\), would be able to differentiate between discomfort-pain, anger and sadness behavioural patterns. Eighteen photographs of one infant (6 photos demonstrating either sadness, pained and angry) were presented to participants. No background information on the photos was given to the participants. Judges were asked to rate each video clip of the infant on eight 7-point affect rating scales ranging from “not-at all” to “extremely”. Each of the eight rating scales corresponded to a different basic emotion that had been proposed by many differential emotional theorists (happy, surprised, disgusted, afraid, angry, sad and pained), with an additional scale addressing the less differentiated emotional term “distressed”. The actual emotions of the infant, to which participants judgments were compared, was based on another facial coding system (AFFEX) and the context in which the infant was videotaped (e.g. happy was considered the appropriate emotion if the infant was playing). Inconsistent with differential emotions theory, judges were not able to correctly distinguish between the three negative emotions. Interestingly, while all three sets of clips received the highest ratings on the ‘distress’ scale, the sadness clips actually indicated a low attribution of any

---

\(^3\) Differential emotional theorists propose that infants experience discrete basic emotions akin to adults, which is reflected in discrete facial expressions. As a child develops, these basic emotions evolve into the blended emotions, different cognitive appraisal processes and coping behaviours seen in adults.
emotion whatsoever. It was also found that the body activity accompanying the
discomfort/pain and anger displays were judged by the participants to be more “jerky”
and “active” than body activity of the sadness display. In terms of the results on the
specific set of pain/discomfort clips, the emotion rating scales that were given the highest
ratings were distress, anger, disgust and sadness while the ratings on the ‘pained’ rating
scale was one of the lowest ratings. This study suggested that when given no context,
judges are able to correctly detect levels of distress in an infant but are not able to make
fine-grained distinctions between different negative emotions.

In reviewing the attribution of infant emotion literature to date, Emde (1993)
noted three principles he considered “hard-won knowledge gained over the past three
decades earned through the efforts of both clinicians and researchers”. He first noted that
development in infancy is a reciprocal and transactional process dependent on the
caregiver-infant dyad. He asserted that the period of infancy is formative in the
development of emotions not solely because of a predetermined biological sequence but
also because infant-caregiver relationships become set in an enduring way that will
continue to develop through childhood and later life. The second principle he asserted
was that humans in infancy demonstrate resilience in their emotional development that
buffers them against environmental hazards. Thus, even with “untoward variations in the
early caregiving environment”, emotional development can get back on track. He
highlights this as a compelling reason to research and investigate how caregivers interact
with their child (and the implications of different types of interactions) as a way to
discern ways to enhance child resiliency in less than optimal caregiving environments.
Emde noted that the final principle was that emotional availability, not just physical
availability, is a central aspect of the adaptive caregiving environment. He stated that a caregiver must not only be physically present with an infant but also sensitive and responsive *over time* to the infant’s unique constellation of emotional expressions.

In summary, past research in the area of attribution of emotion to infants has indicated that adult judges are highly reliable when discerning general negative emotions such as “distress-sadness”. The literature alludes to an evolutionary explanation for such high consistency in that adult humans are prewired to detect distress in an infant because it would perpetuate survival of the infant (and therefore the species). Finally one can also see from a review of this literature that the emotional development of an infant is dependent on his/her caregiver’s physical availability and the caregiver’s sensitivity (attuned over time) to the infant’s emotional cues. Finally, because human emotional development is a resilient phenomenon, research in how to better optimize the caregiver’s ability to interpret an infant’s experiences is recognized as an important area of research. The discussion will now turn to a specific review of how adults, specifically nurses, attribute pain to the infant.

**Nurses’ Pain Attributions**

As aforementioned, much of the work in how pain attributions are made has been conducted with nurses. A review of the literature in this area shows three main areas of focus: key indicators (cues) used by nurses when assessing pain, background characteristics of nurses that impact pain judgments, and more recently, the emergence of theories about the process of infant pain assessment.
Encoder Variables: Infant Judgment Cues

Numerous studies have examined nurses’ self-report of which cues in the pain judgment context were important or frequently used when nurses judge the pain of infants. Information has been elicited by surveying personal opinions of nurses, eliciting beliefs through laboratory pain judgments, or eliciting beliefs in the context of recalling past pain judgments. From these works, general categories of cues were consistently mentioned: vocalizations, body movements or posture, facial expressions, changes in vital sign measures, affect, state, infant health background (e.g. diagnosis or surgical status), consolability, and context, in particular whether infants were in a medical setting (Bradshaw & Zeanah, 1986; Pigeon, McGrath, Lawrence et al, 1989; Jones, 1989; Shapiro, 1993; Fuller, Thomson, Conner and Scanlan, 1996; Fuller & Conner, 1996; Howard & Thurber, 1998; Hudson-Barr, Duffey, Holditch-Davis, 1998; Fuller, Neu and Smith, 1999). One cue that came up only once as being “frequently” used by a sample of nurses was an infant’s ability to “focus on its surroundings” (Fuller, Thomson, Conner and Scanlan, 1996).

Across studies differences often arose in rankings of how important nurses felt these cues were to their pain assessments (importance ratings) or in the proportion of nurses reporting using that particular cue (frequency ratings). Generally summarising this literature, vocalisations and body movements consistently topped the list in either importance or frequency, while the position of other cues varied. Note the earlier review which questions the specificity of these cues to pain. Physiological signs were cues with variable importance and frequency ratings, having been rated as one of the top five cues used in pain judgments in some studies (Bradshaw & Zeanah, 1986; Pigeon, McGrath,
Lawrence et al., 1989; Howard & Thurber, 1998), while not in others (Jones, 1989; Shapiro, 1993; Fuller, Thomson, Conner et al., 1996). Notably despite evidence of facial action and numerous studies noting its usefulness, sensitivity and specificity, some studies reported that nurses did not consider facial action an integral cue (Bradshaw & Zeanah, 1986; Pigeon, McGrath, Lawrence et al. 1989), while other studies found facial action very important to nurses' judgments of pain (Jones, 1989; Shapiro, 1993; Fuller, Thomson, Conner et al., 1996; Hudson-Barr, Duffey, Holditch-Davis et al., 1998; Howard & Thurber, 1998). These stark differences among study findings were not consistently related to the use of different methodologies for eliciting the cue ratings (videotape judgments; hypothetical infants; infant currently in care).

Some studies explored the prioritizing of cues in greater depth. Hudson-Barr, Duffey, Holditch-Davis et al. (1998) performed analyses to establish whether nurses could accurately determine that medication was needed. They showed nurses, blinded as to the medication status of the infant (e.g. having received medication or about to receive medication), video clips of infants in pain. While finding that nurses were not accurate in asserting that medication was needed for infants who were in fact in need of analgesics, researchers found an interesting difference in the utilization of cues. Although they were no more accurate in terms of medication status, nurses who consistently said medication was needed most frequently utilized the cues of facial expression and body movements. Conversely, nurses who consistently stated that no medication was needed utilized the state of the infant most frequently. This suggested that nurses who use more objectively reliable cues would be more apt to medicate an infant.
Shapiro (1993) sought to determine whether different cues were utilised when judging pain in pre-term and full-term infants undergoing a heel lance. Nurses rated vocalisations, body movements and facial expressions as most frequently used in pain judgments for both populations. Furthermore, despite the same pain stimuli, full-term infants received significantly higher ratings of pain. This finding suggested that, by not using developmentally sensitive cues, pre-term infants (known to offer a less vigorous pain response) are in danger of having their pain ignored.

Work by Fuller and colleagues (Fuller, Thomson, Conner and Scanlan, 1996; Fuller & Conner, 1997; Fuller, Neu and Smith, 1999) did not find this infant age effect on pain ratings. It should be noted that these studies utilised a cross-sectional methodology wherein different judges rated different age groups (while Shapiro had the same group of nurses judge both age groups). Significantly higher pain ratings were found to be a result of providing background clinical data as an additional cue prior to a pain assessment (Fuller, Neu and Smith, 1999). Before viewing the videotapes of infants, half their sample was provided with the infant’s age, birth history, number of hospitalizations, reason for admission, parental comments about the infant’s usual behaviour and all medications and nutrition given to the infant during the 48 hours prior to videotaping. The remaining sample simply viewed the videotapes. In another study (Fuller & Conner, 1996), researchers explored whether cues nurses utilised varied depending on the severity of the noxious stimuli the infant had experienced. A sample of 64 nurses of varying experience levels judged videotapes of infants in no pain, mild pain, moderate pain, and severe pain (as determined by an expert panel). The vast majority of cues that nurses spontaneously offered as contributing to their pain judgments did not differ across
levels of pain (45/62 cues). However, some cues that were self-reported by nurses as important ("key cues") distinguished between moderate to severe pain versus no to mild pain (time since surgery, negative responses to routine nursing activities, focusing less on surroundings, difficult to console, crying, grimacing, and stiff posture).

**Decoder Variables: Significant Nurses' Characteristics in Judging Infant Pain**

Fuller & Conner (1997) conducted a study that sought to determine whether level of nursing experience influenced the cues utilised in making infant pain judgments. In a factorial analysis, they initially determined that neither level of nursing experience (paediatric nursing less than one year; between 1-5 years; greater than 5 years) nor age of infant (four age groups ranging between birth to 1 year) resulted in a significant difference in pain ratings. The number of refresher courses, journal articles, and other pain assessment skill building strategies were also not related to nurses' pain ratings of infants. In terms of the nurses' reports of cue utilization, similar categories such as ease of consolability, health information, body movements, and vocalisations were used across experience levels. However, one significant difference found was that less experienced nurses utilised more judgment cues than did more experienced nurses. This may be that with experience nurses have already found cues that they deem are important, while less experienced nurses are still in process of identifying what cues are important, thus utilise a greater number of cues.

However, another study found the opposite relationship between experience and number of cues that nurses reported using for their pain judgments. Bradshaw & Zeanah (1986) found that while the average number of cues reported by nurses was roughly 5, nurses who had been involved in nursing longer used a larger repertoire of cues to form
their judgments. A subsidiary analysis split their sample of 99 paediatric nurses (25% NICU nurses) into those who worked in chronic care settings versus those who worked in acute care settings. There were no significant differences between the cues utilised by chronic and acute care nurses. But Page & Halvorson (1991) found that nurses who work in critical care units (versus non-critical care units), nurses who are taking skill-building classes in pain, or nurses who are willing to administer pain medication to an infant who has undergone a painful stimuli (regardless of behavioural display or state), not only utilise a greater number of cues but also attribute more pain to infants recovering from surgery. One way to reconcile these apparently contradictory findings may be to examine the type of nurses surveyed. The Fuller and Connor (1997) investigation used neonatal nurses only while the other two studies utilised paediatric nurses who worked with older children as well. These conflicting results serve as yet another reminder to avoid generalizing from information learned with older children and adults to infants.

Research Synthesizing the Assessment of Infant Pain

While earlier studies in the infant pain judgment literature focused on individual elements of infant pain assessment, more recent work has begun to synthesize these elements into a bigger picture of how the decision regarding the presence or absence of infant pain is made. Abu-Saad and Hamers (1997) reviewed the decision-making and paediatric pain literature. They emphasised how little work has been done in this area and provided an exhaustive assembly of the main indicators used to encode pain and background characteristics of the judges. In citing two unpublished masters theses from the University of Limburg in the Netherlands (Leegte & Stelwagen, 1993; Koolen & Perduihn, 1991), the investigators also suggested other contextual areas that have been
generally neglected. In both these works, conflicting information regarding the influence of colleagues and other health professions in the decision-making process of nurses was found. Leegte & Stelwagen (1993) found that when in doubt, nurses reported consulting with other nurses before making a judgment. However, Koolen & Perduihn (1991) did not find that information obtained from other nurses, physiotherapists and physicians as particularly helpful. Leegen & Stelwagen (1993) reported that in units where nurses were able to be more patient-focused, as opposed to task-focused, they felt better able to assess pain more adequately. They also reported that orders to administer pain medication on a standard basis (around the clock), as opposed to an 'as needed' or PRN basis, reduced nurses’ hesitation to administer medications to children. Abu-Saad and Hamers (1997) used this collection of information to create a schematic presentation of how various factors influence nurses’ decisions to assess and manage pain. While valuable in collecting a diverse array of information, the schematic presentation did not address issues of reciprocal influences between encoder and decoder, influences of social context on the encoder/decoder, nor offer any type of weighting or ordering of the influence of various categories of cues. The framework can be best construed as conceptual rather than empirically validated.

Fuller (1998) offers a more detailed model of the sequential steps of infant pain management, which takes into account reciprocal influences between an encoder and a decoder. This model does not speculate in regards to specific cues used in making a pain attribution but rather focuses more on the overall process. An interesting aspect of this model was the incorporation of the “principle of consolability”. According to this model, when a nurse confronts an infant in distress, he/she begins to formulate hypotheses about
the likelihood of pain in the context of available clinical data (infant pain cues, medical status, etc). Based on these data, one of three courses of action would be taken. One is that the infant is assessed as experiencing pain; if this were the case then an appropriate intervention would be initiated. Another option would be that the infant is assessed as distressed for a reason that does not involve pain and, accordingly, an appropriate intervention would be taken (e.g. a diaper change). The “principle of consolability” comes into the third scenario, when the situation is ambiguous as to whether or not the infant is in pain. Based on her work in this area over the past decade, Fuller theorizes that when this is the case, nurses will attempt to apply a variety of non-pharmacological strategies (holding, pacifier, stroking, feeding) and mild pharmacological measures (acetaminophen) to the infant. The infant’s reactions to these strategies would then lead to the nurses’ final determination of pain. Fuller theorizes that the process is the same regardless of level of nursing experience.

A subsequent study (Fuller, Neu, Smith and Vojir, 1999) tested one possible aspect of this model and found results in line with what the model predicted. In essence, this study found that nurses judging videotapes of infants in pain (being cared for by a nurse or parent) and provided with basic clinical information judged pain differentially based on the likelihood that pain was present and on the ease of consolability. Thus, pain ratings were highest in the group in which the likelihood of pain was high (e.g. post medical procedure) and the ease of consolability was low (difficult to console), and lowest when the reverse was true. This model was created with the use of qualitative analyses and awaits confirmatory work from a more quantitative statistical modelling viewpoint. Furthermore, while this model can easily be seen as generalizing to a parent,
it appears less easily applicable to how a physician makes a pain judgment given that physicians are not often in extended physical contact with the infant. It also does not incorporate different caregiver factors (e.g. beliefs, previous experience with the child) into the process of infant pain assessment.

A few studies address how clinical judgments in pain were made with adults. Di Giulio & Crow (1997) utilised a “think aloud” technique, with five nurses and five physicians making a pain judgment. They analysed the subjects’ cognitive processes from an information-processing framework. The rationale behind this model was that before making a judgment or decision, an analysis of the situation would be carried out and subsequent cognitive action would be predicated on the analysis of the data. Physicians asked for a larger amount of data and generated a greater number of hypotheses when confronted with the two pain vignettes. Nurses, however, were found to propose a greater number of practical interventions. Two other significant findings in this paper were that physicians revealed a greater use of theoretical knowledge in their decision making process and that nurses appear to collect more information on symptoms other than pain (e.g. psychological variables) suggesting a more global rather than problem-specific approach.

Other investigators have understood pain judgments by health professionals to be more automatic. From this perspective, experience will have led to the development of cognitive shortcuts or heuristics regarding how to make a judgment about pain. Available information is then processed very quickly through a pre-existing knowledge structure (that has been created through past experiences with patients in pain), resulting in a judgment of pain for the present patient. Lander (1990) was one of the first researchers
to suggest this framework within the area of pain. Her subsequent work is confirming the utility of heuristic-type decision making (personal communication, March 8, 2002). Seymour, Fuller, Pedersen-Gallegos et al. (1997), in a largely qualitative analysis regarding the process of infant pain assessment, found that a single element of an infant’s behaviour (either cry, body movement, or facial expression) was very influential in determining pain judgments. More than half of the sample reported using only one of the aforementioned elements to determine the presence of mild, moderate, or severe pain, despite the availability of other information. This pattern of judgment strongly suggests the use of heuristic decision-making.

**Heuristic Decision-making**

Work in pain decision-making has been criticized as lacking a strong theoretical base and utilising samples not representative of the different populations of infant caregivers (Ladner, 1990; Abu-Saad & Hamers, 1997; Di Giulio & Crow, 1997). However, decision-making research within the area of psychology can be traced back to the forties and fifties (Goldstein & Hogarth, 1997). During that formative time, judgment researchers were using as starting points work conducted in the areas of perception, economics, and statistics. Two main lines of thought in judgment analyses were promulgated. One concerned how people decide on a course of action (preferential choice literature), and the other was focused on how people integrate vast quantities of information to form a judgment (judgment literature); where heuristic decision making finds its place. While setting out to explain different phenomena, these two general literatures also overlap considerably. Furthermore reviews tend to portray the area as not only having two main groups but also a multitude of splinter groups with no group
having an overarching theory of decision making that is overwhelmingly satisfying in terms of explanatory capabilities (Kahneman, 1991; Goldstein & Hogarth, 1997).

Initially, the literature proposed a proliferation of sophisticated multivariate models that tried to factor in all the information available to a human judge (Goldstein & Hogarth, 1997). Researchers then began to question the utility of these multivariate models, as judgments that integrated large numbers of variables would exceed the cognitive capabilities of human beings. This questioning was in line with the classic finding in the literature that judgments were almost invariably less accurate than a simple statistical combination of the same information available to the judge, regardless of the experience of said judge (Meehl, 1954). Dawes and Corrigan (1974) bolstered this finding by work suggesting that a predictive numeric formula based on a clinician’s own decision-making processes yielded more valid predictions regarding the clinician’s future decisions than the clinicians’ own self-predictions. Groth-Marnat (p. 29, 1997) further stated that even when actuarial formulas were available they may not apply as “the practitioner must deal with a natural world that is imperfect, constantly changing, does not necessarily follow rules, is filled with constantly changing perceptions and is subject to chance or at least impossible to predict events”.

Heuristics are mental shortcuts that are used when people make judgments regarding uncertain events. Heuristics reduce the complex tasks of assessing probabilities and predicting values to simpler judgmental operations (Tversky & Kahneman, 1974). According to these researchers, the time-saving aspect of these shortcuts can often lead to errors in judgment. While Kahneman and Tversky perceive heuristics as flawed biased constructions and a significant contributor to poor decision
making (1996), Gigerenzer and colleagues (1999) see heuristics as reasonable, adaptive references about the real social and physical world given limited time and knowledge. To prove this point, Czerlinski, Gigerenzer & Goldstein (1999) analysed datasets across 20 different environments in both a heuristic fashion (single best predictor) and an actuarial (multiple predictors) model. The heuristics analyses performed equally or slightly outperformed the multiple linear regression modeling. The investigators concluded that “human inference does not have to forsake accuracy for simplicity. The mind can have it both ways” (p. 117).

Given the multiplicity of factors at play with the caregiver of an infant (e.g. other children requiring care, household or shift duties, spouse or colleague needs) and the relatively negligible ability of a young infant to ensure his/her own safety, it also makes evolutionary sense that humans would evolve to find efficient mental short cuts to make decisions about commonly occurring situations relating to the needs of an infant.

In summary, given the questionable applicability of complex statistical models to understanding human judgment in the more general psychology literature, the magnitude of information available to a caregiver when judging infant pain and the inherent ambiguity of pain in a non-verbal infant, the use of heuristic concepts to better understand pain decision-making appears to be a valuable framework.

Methodological Notes

The methodology of this study was grounded in principles forwarded by Rosenthal (1987), an expert in judgments of nonverbal communication. Rosenthal noted that there are three main components in nonverbal judgment studies: encoders, decoders and encoder nonverbal behaviour. In the present study there were the infants (encoders),
the different populations of judges (the decoders) and the infants’ videotaped behaviour in reaction to the immunization (encoder nonverbal behaviour). His research indicated that “the reliability of the ability to decode different encoders sending the same scenes was, on the average, the same as the reliability of the ability to decode different scenes sent by the same encoder” (p. 304). His appreciation of statistical probabilities arising from extensive experience in conducting judgment studies with nonverbal populations indicated that one should focus on increasing the number of stimuli (infants in this study), if encoders were of central interest or increasing the number of decoders (parents, nurses and paediatricians in this study), if decoders were of interest. Given that judges were of primary interest and because of pragmatic time constraints, the number of infant video clips was limited and efforts were focused on increasing the number of decoders for the analyses.

The basic study protocol involved three different groups of judges (parents, nurses and paediatricians) viewing a set of video clips of healthy infants (infants belonged to one of five age groups) undergoing an immunization. For each infant, participants were asked to make judgments of pain intensity and affect. Then after finishing the pain judgments for a particular age group, participants completed questionnaires regarding their beliefs about the capability of infants (of that age group) and the cues or indicators that they self-reported to be important when making their pain judgments.

Overview of the Proposed Study

The goal of the current study was to conduct a comparative analysis of parent, nurse and paediatrician pain judgments and the beliefs that have contributed to those judgments. This study finds theoretical grounding in Craig’s (2002; See Figure 1)
Sociocommunication Model of Infant Pain. More specifically fitting into the step postulating how a caregiver judges or attributes infant pain. In order to more clearly understand the role of beliefs on pain judgments within this step, the current study controlled other variables postulated by Craig and colleagues as impacting the communication between an infant in pain and his/her caregiver. The context (healthy infant receiving an immunization in a local health unit), the immediate relationship to child (no sample had any \textit{a priori} exposure to infants in the video; nor were the parents related to the infants in the study) and motor programs of the infant (all infants had similar behavioural reactivity, in terms of cry, facial expression and body movements) were held constant, to attempt to isolate the role of beliefs in different caregivers’ (parents, nurses and paediatricians) attributions of pain to infants.

These three groups of caregivers were chosen as they are routinely involved when a child is in pain. Between-group differences were examined because of interest in the differing beliefs and experiences each group would bring into a pain judgment context. Given the infants would not be related to the sample of parents judging them and that some of the paediatricians and nurses were parents, the crucial differences between each group related to the type of pain assessment experience one brings into the current judgment context (e.g. involvement with a related infant or infants, involvement with numerous unrelated infants), the amount and quality of experience one spends with infants (long protracted periods involving basic care of one or more infants or brief interactions with infants mainly for diagnostic and treatment purposes) and the amount of formal medical training each group had. The age of the infant being judged was also
manipulated in order to investigate if differences existed in pain attributions and beliefs about pain attributions as a function of infant age.

It was hypothesized that pain attribution differences would be found among the three samples and across the five age groups. Differences also were speculated in regards to the pain attribution beliefs between the samples and infant age groups. To date, little work has attempted to compare pain ratings and how they are formed among different samples of caregivers. Thus literature-based hypotheses were difficult to make. In comparison to paediatricians, parents and nurses spend more time with infants and are most involved in the basic care of infants; thus, it was hypothesized that parents and nurses would thus be very similar in their pain judgments (due to their similar roles of actual caretaking) and differ from paediatricians. It was further hypothesized that the direction of this difference would be that paediatricians would report higher pain ratings than parents and nurses. Due to earlier postulations in the literature suggesting gender differences in infant pain judgments (Craig, Grunau & Aquan-Asse, 1984; Schechter & Allen, 1986), it was speculated that this gender difference between samples may be an explanation for the higher ratings of pain for the paediatricians. It was expected that the parent and nurse samples would be predominantly female, while the paediatrician sample would be more equally split between genders. Gender may impact pain judgments indirectly as females tend to spend more time with infants. It has been previously suggested in the literature that fathers (versus mothers) and physicians (versus parents and nurses) spend the least time engaged in direct infant contact and therefore have less practical experience in judging infant pain, resulting in higher pain judgments. Moreover, based on the literature comparing premature and full term infants, it was
speculated that despite the fact all infants had undergone the exact same stimulus (immunization needle), in the exact same setting, via technicians of similar experience levels, older babies would be attributed more pain because judges would perceive older infants (compared to younger infants) as more closely approximating how an adult would experience pain.

Finally, in terms of how pain attributions are formed it was hypothesized that physicians would rate a smaller repertoire of cues as important (due to spending less time with each infant), when formulating their pain judgments. In regards to actual beliefs about pain, it was expected that the greater medical knowledge of nurses and paediatricians would result in a belief endorsement pattern more reflective of current research on infant pain.

Methods

Participants

Ethics approval from the University of British Columbia Ethics Review Board (and Children’s & Women’s Institutional Review Board) was obtained separately for data collection for each caregiver sample. Consent forms were similar for all three samples, with the only difference being that the study would be conducted at Science World, a Special Care Nursery or a Paediatrician office (See Appendix 1 for sample). Descriptions of the three samples and unique aspects of data collection are presented separately for each of the three samples.

Parents. Forty-nine parents (40 mothers and 9 fathers; M age = 41.02 years, SD = 9.02) were recruited over a two week period at an interactive, child-oriented science
museum, through on-site posters requesting participation of volunteer parents in a study of children’s pain and distress (Appendix 2). This sample (as determined by self-report) was predominantly Caucasian (88%), with 12% identifying another ethnic background (6% Asian; 4% unidentified; 2% African). Interested parents were instructed via the poster to go to the study booth which was set up in a common area of the museum away from the displays. Of parents approaching the booth, 53 declined participation once hearing the study explanation. The majority declined due to time requirements of the study (64%), while others declined due to “being on vacation” (9%), or an opinion opposing the routine immunisation of children (2%). For 25% of the ‘decliners’, the reason for refusing participation could not be determined.

The judgment portion of the study took place in a closed room, adjacent to the recruitment booth. Children of participating parents remained outside of the judgment room and under the supervision of another Research Assistant (RA). The children participated in age-appropriate activities designed to teach children about the pain and the brain (see Appendix 3). Remuneration was a discount coupon from a popular food vendor on the premises. The educational level of volunteer parents varied somewhat, with more than half of the sample having one or more university degrees (high school or less = 8; trade school = 9; some university = 7; undergraduate degree = 12; graduate school or other professional programs = 13). To characterize the level of background parents had in infant development and care, they were asked two questions: 1) “Have you taken any courses in infant development and care and, if so, how many?” and 2) “Does your occupation directly or indirectly relate to infant development and care?” Twenty parents had completed courses in infant development or care (mean number of courses = .452;
The majority of parents who participated in this study did not have an occupation that related to infants, either directly or indirectly (not related to infants = 37; indirectly = 2; directly = 9).

Nurses. Fifty female nurses (M age = 38.68, SD = 8.69) were recruited from the Special Care Nursery (SCN) of British Columbia’s Children’s Hospital. A month prior to data collection, nurses were briefed by the primary investigator about the opportunity to participate in the current study. This information was conveyed during regular refresher workshops organised bi-annually by clinical nurse leaders. All nurses in the SCN (162 full- and part-time nurses) are required to attend one of these workshops. Subsequent to the workshop, study advertisements were posted throughout staff areas in the SCN (Appendix 4).

Trained RAs conducted data collection in an enclosed meeting room within the SCN over a two months time period between 21:00 and 23:00 hours. This time period was negotiated with the administrators because it was judged to be least disruptive to the SCN. Due to regular shift rotations, the vast majority of nurses would be scheduled to work at least one week in a shift that would coincide with data collection dates and times. Nurses were asked by their daily team leader if they wanted to participate and the team leader then relayed the information to the RAs. For compensation, nurses were offered a coupon for a hot beverage and muffin at a popular coffee vendor in the hospital. The nurses’ self-reported ethnicity demonstrated that the sample was mainly Caucasian (64%), with the rest of the sample comprised of nurses of Asian (26%) and African (2%) descent. Eight percent did not identify their ethnicity. All the nurses were female and notably there were no male nurses on staff at the SCN during this study period. The
number of years of nursing experience ranged between 2 and 37 years (M = 14.97, SD =
8.80). When asked to report when they first received education on infant pain, only 32%
noted that it was obtained during their formal training. Roughly half of the nurses (54%)
learned about infant pain after they graduated, and 14% had never received any
specialized training despite their specialized placement in neonatal nursing.

**Paediatricians.** Paediatricians were recruited from the community to participate in
this study over a period of ten months. Recruitment was undertaken in three ways: three
waves of written contact, newsletter advertisements, and direct contact. Initially, every
paediatrician registered with the British Columbia College of Physicians and Surgeons
who practiced in Vancouver, Burnaby, North Vancouver, West Vancouver, or Richmond
was sent a letter (Appendix 5) asking them to participate. One hundred and twenty-five
paediatricians (93 in Vancouver; 32 in surrounding areas) were contacted; however, six
of these letters were returned as they were undeliverable due to death or relocation of the
paediatricians. If paediatricians did not respond and did not decline participation, a letter
was faxed out to their offices after approximately four weeks. Four weeks subsequent to
sending the fax, a final letter was mailed to their office requesting participation. A
second strategy to recruit paediatricians used brief advertisements (see Appendix 6)
placed in both the British Columbia’s Children’s Hospital (BCCH) Department of
Pediatrics Newsletter (June 2002) and the British Columbia’s Paediatricians Society
Newsletter (October 2002). Finally, participants were recruited through brief
presentations at a BCCH Department of Pediatrics (June, 2002) meeting and the Annual
General Meeting of the British Columbia Paediatricians Society (November, 2002). All
licensed paediatricians practicing in the Lower Mainland should have received the three
written communications regarding the study, while the majority of paediatricians affiliated with BCCH would have been exposed to all three recruitment strategies.

Regardless of the method of recruitment, paediatricians were asked to contact the laboratory to set up an appointment for an RA to go to the paediatrician’s office and conduct the study protocol. Paediatricians were offered a bagged lunch of their choice prepared by university catering services, or a ten dollar cash honorarium. If the physicians opted for the lunch, they were informed in advance and at the time of the experiment that they were not allowed to eat the lunch during the study period.

The self-reported ethnicity of the paediatricians was predominantly Caucasian (90.2%), with the rest of the sample comprised of individuals of Asian (7.3%) and Unspecified/Other (2%) descent. The mean number of years in practice ranged between 1 and 35 years ($M = 16.03$, $SD = 9.85$). When asked to report when they first received education on infant pain, 43.9% noted that it was obtained during their formal training. Roughly one-fifth of the paediatricians (19.5%) learned about infant pain after they graduated, and 36.6% reported never having had any specialized training regarding pain in infancy.

Procedure

The same study protocol was used with each sample. Research Assistant (RA) training was conducted by the same investigator (R.P.R.) across all three studies. After reading a detailed manual and completing a two hour training workshop, RA’s performed two mock subject protocols correctly in front of the key investigator before working with ‘real’ subjects. Because the data collection period for the paediatricians required a protracted time span, RAs for the paediatrician study were tested for protocol fidelity
midway through data collection. Slight deviations from protocol were addressed at that time.

Participants watched the video clips on a JVC portable TV/VCR with a 13” screen. All participants met alone with the experimenter in an enclosed area when going through the protocol. RAs were explicitly instructed to place participants in a manner such that no subject had a clear view of the experimenter’s facial expression during the judgment phase. RA’s were also instructed to discretely limit contact with subjects during the judgment phase.

Participation in this study required four stages of activity. The pre-video stage began with obtaining consent from subjects. They were then asked to complete a demographics form. Subjects were then briefed about the judgment portion of the study using a structured script (Appendix 7) and the viewing of a sample video clip of an infant receiving an immunization. The health status of the infants and location the videos were taped at (local immunization clinic) were emphasized in the script. The age of the sample infant was not disclosed to the judges to avoid potentially biasing subsequent pain judgments. The second stage involved participants judging a ten-second video clip of an infant from a particular age group (2 months, 18 months, etc) undergoing an immunization. The third stage came after watching each individual video clip. Participants rated the severity of each infant’s pain in terms of intensity and affective dimensions. Stages two and three were repeated for all video clips being judged. The final stage came after subjects had viewed all the video clips of a particular age level (see following for detailed description of judgment video clips). Participants completed two
judgment questionnaires examining their perception of the determinants of their pain judgments. This judgment procedure was repeated for all five age groups of infants.

**Apparatus**

**Video Stimuli.** Participants viewed a collection of video clips randomly selected from a sample of 75 video clips depicting healthy babies receiving routine immunisation at a local health unit (Lilley et al., 1997). Video clips were excluded if parental facial expressions predominated or if the infants displayed no cry, body movements or facial activity in response to the needle. To further ensure that facial activity did not differ among the 20 video clips selected, each video clip was coded using the NFCS. Using slow motion and stop frame feedback, a trained research assistant coded each 10 second clip. One coder conducted the main NFCS coding, with 10 of the infants (50%) scored independently for inter-rater reliability. Inter-rater reliability was found to be extremely high (.96).

Previous studies indicate that facial actions occurring less than 3 to 10% of the time should not be analyzed because they do not occur with sufficient frequency to be analyzed (Craig, Whitfield, Grunau, Linton and Hadjistavropoulos, 1993; Hadjistavropoulos, Craig, Grunau and Whitfield, 1997; Grunau, Oberlander, Hosti and Whitfield, 1998). Review of the occurrence of facial actions within the current 20 clips in question, indicated that only 7 of the 10 facial actions occurred with the required frequency. Thus, lip purse, chin quiver and tongue protrusion were not further analyzed. This selection of variables replicates previous findings (Craig, Whitfield, Grunau, Linton and Hadjistavropoulos, 1993; Oberlander, Grunau, Whitfield, Fitzgerald, Pitfield and Saul, 2000). The seven facial actions were summed to provide an overall index of facial
activity (M = 29.95 SD = 4.80). The maximum NFCS score for a 10 second period, using 7 facial actions was 35. While constraints of power preclude proper significance testing, an informal comparison of this summary score across the 20 clips indicated similar levels of facial activity across all clips.

Each video clip displayed an infant’s facial pain expressions and body movements for ten seconds, starting with the exact moment of skin puncture (as determined through time-date generated stamps recorded during the initial recording of these tapes). Each baby demonstrated a loud, clear cry after needle insertion. Throughout the duration of each video clip, the baby’s age appeared clearly in the upper right hand corner of the screen. Between each video clip, a blank blue screen delineated the beginning and end of each clip, providing time for the RA to pause the video in order for the participants to make ratings. Video clips of infants within the same age group were always grouped together on the judgment video. The age groups were presented to subjects in a random order to control for potential serial order effects of age and carry-over effects (Kazdin, 1998). Due to time constraints imposed by the science museum, each parent judged the reactions of ten video clips (two infants from each of the five age levels), while paediatricians and nurses viewed twenty video clips (four infants from each of the five age levels). The ten infants that were shown to parents were also shown to paediatrician and nurses, with an additional ten clips being shown to both the nurses and paediatricians as increased viewing time was permitted. Of the twenty clips used in this study, seventy-five percent of the randomly selected infants were of Caucasian descent (15 infants), while the remaining infants were of varied non-Caucasian backgrounds. Among the age groups, there was one non-Caucasian infant in the 2 months old group of video clips, two
non-Caucasians in the 4 months old group, one non-Caucasian in the 6 months old group and one non-Caucasian in the 18 months old group.

**Measures**

**Pre-Video Package.**

*Demographic Form:* Subjects provided basic demographic information, including age, gender, ethnicity, level of education, years of experience, and whether they had received infant pain education (See Appendix 8).

*Belief Questions.* At intervals during the Pre-Video package, the judges were asked the following two questions (see Appendix 9): 1) At what age do you believe children can experience pain?; 2) At what age do you believe it is appropriate to begin to administer a pain-relieving medication?. For both questions, participants were asked to circle one of the following age groups: birth-1 month, 1-4 months, 4-8 months, 8-12 months, 12-18 months and 18 months or older. These questions and slight variations of them are prevalent in the literature (Schechter & Allen, 1986; Franck, 1987; Pigeon, McGrath, Lawrence, 1989; Page & Halvorson, 1991; McLaughlin, Hull, Edwards et al, 1993; Broome, Richtsmeier, Maikler et al., 1996; Porter, Wolf, Gold et al, 1997 and others). These questions were included to determine the relationships of these beliefs to actual pain judgments across caregiver samples.

**Video Judgment Package**

*Pain Intensity and Affect (Visual Analogue Scale; Differential Descriptor Scales):* The VAS is considered a sensitive and reliable measure of the intensity of pain (Abu-Saad, Bours, Stevens et al., 1998). It has been shown to be quick to use and easy to understand even if one's mother tongue is not English (Flaherty, 1996). High convergent
and divergent validity, and adequate test-retest and inter-rater reliability of this measure is well established in the area of pain (e.g. Luria, 1975; Joyce, Zutshi, Hrubes and Mason, 1975; Revill, Robinson, Rosen et al., 1976; Melzack & Katz, 1999).

Participants rated the severity of each child’s pain by placing a mark on a 100 millimetre (mm) Visual Analogue Scale (VAS), anchored by “No Pain” and “Worst Pain Possible”, a length which is now considered standard in the field (Shapiro, 1993; Abu-Saad, van den Hout et al, 1997 and others). A VAS score exceeding 30 millimetres (mm) is generally accepted as indicating clinically significant pain (Collins, Moore and McQuay, 1997).

Each infant was also judged on a modification of the Descriptor Differential Scales of pain intensity (DDS-I) and pain unpleasantness (DDS-U; Gracely & Kwilosz, 1988; See Appendix 10). This scale has been demonstrated to have strong reliability and validity (Gracely & Kwilosz, 1988; Gracely, 1992; Doctor, Slater and Hampton Atkinson, 1995; Melzack & Katz, 1999). To assist judges in distinguishing between intensity and unpleasantness, judges were given an example utilizing the intensity and affect associated with a favourite song versus a loathed song being loudly played on a radio (Craig, Grunau and Aquan-Assee, 1988; see Appendix 7 for script). Judges were explicitly asked if they understood the difference between the scales and research assistants were given specific instructions regarding how to explain the scales further if necessary.

Both scales contained graded verbal pain descriptors used to depict varying levels of pain intensity and pain affect (separate scales for intensity and unpleasantness). Each descriptor scale ordered descriptors from highest intensity (or unpleasantness) at the top...
of the scale to descriptors of the lowest intensity (or unpleasantness) at the bottom of the scale.

Participants were asked to simply select the verbal descriptor that best depicted the pain intensity and then the pain unpleasantness that the infant they were judging had experienced. Each of the verbal descriptors was assigned a rank value from 0 to 12 (intensity: 0 = no sensation of pain versus 12 = extremely intense; unpleasantness: 0 = no discomfort versus 12 = very intolerable).

Self-Reported Explanations of their Pain Judgments

A review of the literature revealed no instruments that quantitatively examined either the judges' beliefs about an infant in pain's developmental capabilities or on the differential importance of cues used to formulate infant pain judgments. Thus, two questionnaires were developed, one to assess development beliefs (Capabilities Questionnaire) and the other to determine the relative importance of different cues used to attribute pain to the infants (Importance of Cues Questionnaire).

After all infants of an age group were viewed, these two questionnaires were completed with items based on precedents in the literature (Bradshaw & Zenah, 1986; Franck, 1987; Jones, 1989; Fuller & Connor, 1996; Fuller, Thomson, Conner and Scanlan, 1996; Hajistavropoulos, Craig, Grunau & Whitfield, 1997; Howard & Thurber, 1998).

The Capabilities Questionnaire: This questionnaire provided 10 statements examining parental beliefs about infants' capabilities to experience pain (see Appendix 11). Each item provided three alternative responses: true, false, and unsure. Instructions indicated that “we are interested in your reasons for giving the pain estimate you did for
this age group" and described the response format.

*The Importance of Cues Questionnaire:* This questionnaire (see Appendix 12) was designed to elicit ratings of the importance of 12 common cues in judgments of pain. Participants were asked to rate each cue on a scale ranging from 0 ("not at all important") to 10 ("extremely important"). The cues were the "the infants' capacity to understand pain", "the infants' capacity to remember pain", "the infants' age", "the infants' sounds", "the infants' facial expression", "the infants' size", "the infants were in a medical setting", "the infants had just received a needle", "the infants' mood", "the infants' body movements", "the infants were healthy", and "the infants' capacity to focus on their surroundings". Judges were provided two blanks to write in and rate other cues that they felt were important to their pain judgments that were not included on the questionnaire. Through this methodology, researchers were able to differentiate between judges' beliefs about infants' pain and the importance of that belief to their actual pain judgments.

**Results**

Because of the planned use of multivariate statistics for analyses, equal sample sizes between the groups were obtained by the process of random deletion of subjects from the parent (8 participants deleted) and nurse (9 participants deleted) samples. The grand total of subjects entered into subsequent analyses was 123 (41 subjects in each of 3 groups). Primary analyses on the pain variable and secondary analyses on the remaining variables will follow after a discussion of demographics, analyses subsuming the combination of the pain variables and the randomization check.
Demographics

Demographic characteristics of the participants, broken down by group affiliation appear in Table 1. A one-way analysis of variance (ANOVA) and Tukey’s post-hoc procedure were used to examine group differences in participant’s age. Results revealed that paediatricians were significantly older than both parents and nurses ($F_{2,120} = 9.20, p < .001$). A series of chi-square analyses were used to examine group differences on the categorical measures. These analyses indicated that while self-identified ethnicity did not significantly differ among groups, significant differences did exist among the three groups in regards to the gender distribution ($\chi^2(2) = 36.77, p < .001$) and the proportion of participants who were parents ($\chi^2(2) = 23.89, p < .001$). The significant gender discrepancy appeared to be due to the nurse sample being 100% female, while the paediatricians were more equally distributed between the two genders. The significant ‘parental status’ discrepancy was due to the fact that 100% of the parent sample necessarily were parents, while the nurse sample was more equally split between the two alternatives (parent versus not).

Relationships Among the Pain Judgment Variables

Missing values were replaced with the cell mean rating (15 cells total; 3 samples by 5 infant ages). In total, 24 missing values (of a total of 2310 ratings across the three pain measures) were replaced (1%). Due to the undue influence caused by extreme scores that are not truly a part of a given sample, univariate outlier analyses using a decision rule of a z-score exceeding 3.29 were conducted (Tabachnick & Fidell, 2001) and no problematic values were found.
Table 1

Demographic Characteristics by Sample Affiliation

<table>
<thead>
<tr>
<th></th>
<th>Parent (n = 41)</th>
<th>Nurse (n = 41)</th>
<th>Paediatrician (n = 41)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant's Age</td>
<td>M = 39.61</td>
<td>M = 37.95</td>
<td>M = 45.68</td>
</tr>
<tr>
<td></td>
<td>SD = 7.60</td>
<td>SD = 8.80</td>
<td>SD = 9.28</td>
</tr>
<tr>
<td>Participant's Gender</td>
<td>Female = 34</td>
<td>Female = 41</td>
<td>Female = 18</td>
</tr>
<tr>
<td></td>
<td>Male = 7</td>
<td>Male = 0</td>
<td>Male = 23</td>
</tr>
<tr>
<td>Participant's Background</td>
<td>White/Caucasian</td>
<td>White/Caucasian</td>
<td>White/Caucasian</td>
</tr>
<tr>
<td></td>
<td>n = 35</td>
<td>n = 27</td>
<td>n = 37</td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>Asian</td>
<td>Asian</td>
</tr>
<tr>
<td></td>
<td>n = 3</td>
<td>n = 11</td>
<td>n = 3</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>Other</td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>n = 3</td>
<td>n = 3</td>
<td>n = 1</td>
</tr>
<tr>
<td>Participant's Parental Status</td>
<td>Yes = 41</td>
<td>Yes = 22</td>
<td>Yes = 29</td>
</tr>
<tr>
<td></td>
<td>No = 0</td>
<td>No = 19</td>
<td>No = 12</td>
</tr>
</tbody>
</table>
Correlational analyses were run between the three dependent variables relating to pain (VAS, DDS-I, DDS-U). Correlations can be found in Tables 2 to 6, broken down over the age of the infant that the pain judgments were based. Due to the preponderance of correlations greater than .60 (Tabachnick & Fidell, 2001), the variables were considered too strongly related to conduct a traditional MANOVA and a principal components analysis was run to determine how the variables could be optimally combined to form a new variable.

Assumptions of a principal components analysis (PCA) were examined on each of the 15 cells. Data screening indicated multivariate normality (tested by skewness and kurtosis statistics and examining frequency histograms) and linearity (examination of bivariate scatterplots) were not issues. Correlations between the three pain variables at each of the 15 cells were examined for homogeneity via three separate chi-squares. Each test was conducted to detect significant differences among 15 correlation coefficients. These analyses indicated that the relationships between the VAS, DDS-I and DDS-U did not differ across the 15 cells. PCA weights were derived on the mean-deviated scores (mean for each cell). Thus, all 15 cells were pooled to form the correlation matrix for the PCA. Standardized PCA weights were divided by each variable’s pooled (over 15 cells) standard deviations before being applied to the raw scores (see Table 7).

---

4 The first chi-square examined the correlation between VAS and DDS-I for all 15 cells ($\chi^2_{(14)} = 21.72, p > .05$). The second chi-square examined the correlation between VAS and DDS-U for all 15 cells ($\chi^2_{(14)} = 14.29$) and finally the third chi-square examined the correlation between DDS-I and DDS-U ($\chi^2_{(14)} = 14.72$). Procedure taken from Glass & Hopkins (1996).
Table 2

Correlations between Pain Judgment Variables for 2 Month Olds

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.45</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.56</td>
<td>.88</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.71</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.61</td>
<td>.84</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Paediatrician</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.72</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.62</td>
<td>.82</td>
<td>1.00</td>
</tr>
</tbody>
</table>

p < .001 for every correlation
Table 3

Correlations between Pain Judgment Variables for 4 Month Olds

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.76</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.75</td>
<td>.84</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.60</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.47</td>
<td>.77</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Paediatrician</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.76</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.59</td>
<td>.732</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*p* < .001 for every correlation
Table 4

Correlations between Pain Judgment Variables for 6 Month Olds

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.85</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.76</td>
<td>.85</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.72</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.51</td>
<td>.73</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Paediatrician</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.79</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.57</td>
<td>.76</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*p < .001 for every correlation*
### Table 5

**Correlations between Pain Judgment Variables for 12 Month Olds**

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.73</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.57</td>
<td>.85</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.50</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.49</td>
<td>.71</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Paediatrician</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.76</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.66</td>
<td>.78</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*\(p < .001\) for every correlation*
Table 6

Correlations between Pain Judgment Variables for 18 Month Olds

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.72</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.46</td>
<td>.66</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Nurse</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.58</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.62</td>
<td>.77</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Paediatrician</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VAS</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS-I</td>
<td>.76</td>
<td>1.00</td>
<td></td>
</tr>
<tr>
<td>DDS-U</td>
<td>.52</td>
<td>.73</td>
<td>1.00</td>
</tr>
</tbody>
</table>

*p < .001 for every correlation*
Table 7
Principal Component Weights and Pooled Standard Deviations

<table>
<thead>
<tr>
<th></th>
<th>VAS</th>
<th>DDS-I</th>
<th>DDS-U</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardized Principal Component Weight</td>
<td>.845</td>
<td>.932</td>
<td>.887</td>
</tr>
<tr>
<td>Pooled Standard Deviation</td>
<td>17.27</td>
<td>1.68</td>
<td>1.468</td>
</tr>
</tbody>
</table>

Finally, in order to facilitate dissemination of findings, a linear transformation was utilized in order to have the metric of the principal component variable approximate the mean and standard deviation of the Visual Analogue Scale (an easily understood scale for pain researchers). This new variable ranged from approximately 0 to 10 (.33 to 9.56), with higher values indicative of higher pain. Thus a new summary pain variable (henceforth labelled ‘meta-pain’ variable) was created from appropriately weighting and summing the three different pain measures. The co-efficient alpha for this new variable, based on the eigenvalue of the first principal component (2.370), was .87 and is indicative of high reliability (Murphy & Davidshofer, 2001). The very similar weightings of all three variables are also indicative of the fact that the intercorrelations between all three variables are similar.

Randomization Check: Effect of Video Clip Order

To ensure that the video a subject viewed (i.e. each video presented the same five infant age groups in one of five different random orders) did not impact pain ratings, five one-way ANOVAS were run on the meta-pain rating for each of the three groups. Thus each one-way ANOVA compared a sample’s (e.g. parents’) pain ratings of an age group.
(e.g. 2 month olds) using the video watched (five different videos) as the grouping factor. A decision rule of $p < .05$ was used for each ANOVA (a conservative choice of alpha given the total number of comparisons and the special concern regarding type-II error). All fifteen ANOVAs resulted in non-significant results. Therefore, it was concluded that the randomly assigned orders of age group presentation did not impact summary pain ratings.

**Primary Analysis: Profile Analysis on the Meta-pain Variable**

Because of heterogeneity of the variance-covariance matrices of the meta-pain variable (Box's $M = 114.137, p < .001$), a profile analysis was conducted. A cursory examination of the heterogeneous variance-covariance matrices indicated that the variances and covariances between the 5 PCA scores (2 months, 4 months, 6 months, 12 months and 18 months) for the parents tended to have greater variability than the nurses and the paediatricians. Profile analysis is an alternative to the better known between-within ANOVA. While testing the same hypotheses, it makes less stringent assumptions. The dependent variable (meta-pain variable) met the assumption of commensurability (i.e. been subjected to the same scaling technique). An overall family-wise error rate of $\alpha = .15 \, (.05 \text{ per test})$ was used for the three hypotheses tested in the profile analysis.

Examination of the assumptions of multivariate normality and linearity demonstrated that they were not of concern for the profile analysis. Looking across the

---

5 In a between-within design, one tests for the interaction, the between-groups effect and the within-groups effect. The equivalents in a profile analysis, respectively, are the test for parallelism, the test of levels and the test of flatness.
15 cells, five univariate outliers were detected. At the multivariate level, outliers were examined by Mahalanobis's distance, leverage values and Cook's distance. No problematic multivariate outliers were detected.

The test for parallelism indicated that there was no interaction between the two factors (Group and Age of Infant) affecting the pain judgments ($F_{g,480} = 2.08, p > .05$). Both the tests for levels ($F_{2,120} = 3.26, p < .05$) and flatness ($F_{4,117} = 14.814, p < .001$) resulted in significant findings. Figure 2 graphically depicts the means on the meta-pain variable across groups and age groups.

Figure 2. Means on the Meta-Pain Variable: Sample by Age Groups

---

6 Upon further examination the five outliers were caused by one subject in particular (a parent with lower pain ratings for each of the 5 infant age groups).

7 Decision rules for these statistics were as follows. Mahalanobis's Distance can be no greater than Chi-Square = 20.515 with 5 degrees of freedom (Tabachnick and Fidell, 2001). Leverage values (in combination with Mahalanobis's Distance) can be no greater than .5 (Neter, Wasserman and Kutner, 1990). Cook's Distance scores can be no larger than 1.00 (Tabachnick and Fidell, 2001).

8 Because of the violation of the homogeneity of variance-covariance assumption, the overall test for flatness utilized a contrast matrix in conjunction with the pooled within-group covariance matrix, that contrasted the 18 month olds from each of the 2 month, 4 month, 6 month and 12 month olds.
The significant one-way ANOVA result obtained in the test of the levels hypothesis was followed up by Tukey’s post-hoc procedure (with α set to .05). Among the groups, follow-up analyses indicated that paediatricians attributed significantly lower levels of pain than parents but nurses did not differ from either of the other two groups. When following up the flatness hypothesis (age differences), components of the contrast matrix used in the overall test of flatness were used to test each of the 2 months, 4 months, 6 months and 12 months age means in turn against the 18 months mean – with a family-wise Type I error rate of .05 (Morrison, 1990). Results indicated that the mean meta-pain ratings for 2 month olds, 4 month olds and 6 month olds were significantly lower than the 18 month olds. Overall, this pattern consistently demonstrated that older babies were attributed higher levels of pain than younger babies. Marginal means are provided in Table 8.

Within-Sample ‘Gender’ and ‘Parental Status’ Post-hoc Analyses: Did Gender or Parental Status contribute to Between Group Differences? Given the significant between-group differences in regards to the sample compositions (gender and parental status), post-hoc analyses were conducted comparing males versus females and parents versus non-parents on each age group’s meta-pain ratings. Relevant analyses were run separately for each sample. Bonferroni-corrected (α = .01 for each t-test) independent samples t-tests were run. Despite significant differences in the number of males versus females, and parents versus non-parents, no heterogeneity of variance accompanied the unequal n’s (Levene’s test for Homogeneity of Variance) for any of the 20 t-tests ran.

---

9 Assumption violations precluded the use of a Hotelling’s T-square procedure.
10 Gender: Five t-tests compared males’ and females’ meta-pain ratings (2, 4, 6, 12, 18 month) in the parent sample. Five t-tests compared males’ and females’ meta pain ratings in the paediatrician sample. No gender follow up was done on the nurse sample, as the sample was 100% female. (continued)
Table 8

Profile Analysis: Estimated Marginal Means of the Meta-pain Variable

<table>
<thead>
<tr>
<th>Age</th>
<th>Parent</th>
<th>Nurse</th>
<th>Paediatrician</th>
<th>AGE MEANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 month olds</td>
<td>M = 6.10</td>
<td>M = 6.17</td>
<td>M = 5.79</td>
<td>6.02(^1)</td>
</tr>
<tr>
<td></td>
<td>SD = 1.82</td>
<td>SD = 1.38</td>
<td>SD = 1.46</td>
<td></td>
</tr>
<tr>
<td>4 month olds</td>
<td>M = 6.63</td>
<td>M = 6.27</td>
<td>M = 5.88</td>
<td>6.26(^1)</td>
</tr>
<tr>
<td></td>
<td>SD = 1.77</td>
<td>SD = 1.21</td>
<td>SD = 1.50</td>
<td></td>
</tr>
<tr>
<td>6 month olds</td>
<td>M = 6.79</td>
<td>M = 6.52</td>
<td>M = 5.97</td>
<td>6.42(^1)</td>
</tr>
<tr>
<td></td>
<td>SD = 1.84</td>
<td>SD = 1.27</td>
<td>SD = 1.52</td>
<td></td>
</tr>
<tr>
<td>12 month olds</td>
<td>M = 6.97</td>
<td>M = 6.65</td>
<td>M = 6.00</td>
<td>6.54</td>
</tr>
<tr>
<td></td>
<td>SD = 1.73</td>
<td>SD = 1.13</td>
<td>SD = 1.56</td>
<td></td>
</tr>
<tr>
<td>18 month olds</td>
<td>M = 7.02</td>
<td>M = 6.89</td>
<td>M = 6.07</td>
<td>6.66</td>
</tr>
<tr>
<td></td>
<td>SD = 1.70</td>
<td>SD = 1.19</td>
<td>SD = 1.48</td>
<td></td>
</tr>
<tr>
<td>SAMPLE MEANS</td>
<td>5.94(^a)</td>
<td>6.50(^a,b)</td>
<td>6.70(^b)</td>
<td></td>
</tr>
</tbody>
</table>

Note. Sample means having different letter superscripts were significantly different (Family-wise p < .05) using the Tukey post-hoc comparison method.

Note. Age means having a "1" superscript were significantly different (Family-wise p < .05) from the 18 month old age mean using the Tukey post-hoc comparison method.

(cont’d) Parental Status: Five t-tests compared parents and non-parents in the nurse sample. Five t-tests compared parents and non-parents in the paediatrician sample. No parental status follow up was performed on the parent sample as the sample was entirely comprised of parents.
In both the parent and paediatrician samples, no significant gender differences were found for any of the age group meta-pain ratings. Furthermore, no significant differences between parents and non-parents were found in either of the nurse or paediatrician samples.

Secondary Analyses: Examining Attitudes and Beliefs

Analyses examining overall beliefs.

A family-wise error rate of .05 was used for the two chi-squares analyzing the two overall belief statements (.025 per test).

*At what age do you believe children can experience pain?* All three groups overwhelmingly responded that infants are able to experience pain at ‘birth -1 month’ (See Table 9). A chi-square analysis to determine if the proportion of subjects that endorsed ‘birth-1 month’ versus an older age group differed among the samples. This result indicated no significant group differences ($\chi^2(2) = 5.76, p > .05$). Examining the proportions, all three groups overwhelmingly believed that even the youngest group of children (birth-1 month) can experience pain.

*At what age do you believe it is appropriate to begin to administer a pain-relieving medication?* A chi-square analysis was conducted to determine if the proportion of subjects that endorsed ‘birth-1 month’ versus an older age group differed among the samples. This analysis indicated that the proportion of subjects that endorsed ‘birth-1 month’ versus an older age group did in fact differ among the samples ($\chi^2(2) = 19.13, p < .001$). While paediatricians and nurses overwhelming responded ‘birth -1 month’, parents were more variable in their selection of the appropriate age of to medicate an infant for pain (See Table 10).
Table 9

Frequency Table: “At what age do you believe children can experience pain”.

<table>
<thead>
<tr>
<th></th>
<th>Birth – 1 month</th>
<th>Older than 1 month</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parent</td>
<td>36</td>
<td>5</td>
<td>41</td>
</tr>
<tr>
<td>Nurse</td>
<td>39</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Paediatricians</td>
<td>41</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>TOTAL</td>
<td>116</td>
<td>7</td>
<td>123</td>
</tr>
</tbody>
</table>

Note. $\chi^2(2) = 5.76, p > .05$

Table 10

Frequency Table: “At what age do you believe it is appropriate to begin to administer a pain-relieving medication”

<table>
<thead>
<tr>
<th></th>
<th>Birth – 1 month</th>
<th>Older than 1 month</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents</td>
<td>27</td>
<td>14</td>
<td>41</td>
</tr>
<tr>
<td>Nurse</td>
<td>38</td>
<td>3</td>
<td>41</td>
</tr>
<tr>
<td>Paediatricians</td>
<td>40</td>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>TOTAL</td>
<td>105</td>
<td>18</td>
<td>123</td>
</tr>
</tbody>
</table>

Note. $\chi^2(2) = 19.13, p < .001.$
Analyses involving the Cue Importance Ratings and Belief Statements across the Age Groups.

Analyses on the cue importance ratings and belief statements were conducted to help elucidate the differences on the meta-pain variable. Given the pattern of differences on the meta-pain variable, secondary between-group analyses were only conducted on the importance ratings for the youngest (2 months) and oldest (18 months) infants to reduce the number of statistical tests being run.

*Cues of greatest importance:* All cues (refer to Appendix 12) in which at least one group of judges had a mean importance rating greater than 5 (moderate importance) were examined for between group differences. It was decided that significant differences on cues that were not deemed moderately important or greater by at least one of the groups were not germane to the purposes of this particular analysis. For the ratings made on the 2 month olds, this resulted in 5 cues flagged for further analysis. Eleven cues were flagged for the analysis of the importance ratings for the 18 month olds.

Two multivariate analyses of variance (MANOVAs) on the importance ratings of cues for the 2 and 18 month olds were conducted using a family-wise error rate of .10 (.05 for each test). Assumptions for both MANOVAs were examined and considered met. Wilks' lambda was used as the multivariate test as it has good power and it is most commonly used for multivariate analyses (Tabachnick & Fidell, 2001). Both the MANOVA for the 2-month olds ($F_{10,232} = 2.90, p < .002$), and the MANOVA for the 18-month olds ($F_{22,218} = 2.26, p < .002$) were significant (see Table 11 and Table 12). A series of one-way ANOVAs and Tukey's post hoc comparisons followed up the
Table 11

MANOVA on Importance of Cues Ratings for 2 month olds: Means (and Standard Deviations) for Follow-up Comparisons

<table>
<thead>
<tr>
<th></th>
<th>2 MONTHS</th>
<th>Parent</th>
<th>Nurse</th>
<th>Paediatrician</th>
</tr>
</thead>
<tbody>
<tr>
<td>The infants' age</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>The infants'* Sounds</td>
<td>8.93&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.80&lt;sup&gt;b&lt;/sup&gt;</td>
<td>7.32&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.65)</td>
<td>(1.62)</td>
<td>(2.17)</td>
<td></td>
</tr>
<tr>
<td>The infants' capacity to understand pain</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>The infants' capacity to remember pain</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>The infants' sizes</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>The infants were in a medical setting</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
<tr>
<td>The infants' facial expressions</td>
<td>8.46</td>
<td>8.54</td>
<td>7.89</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.47)</td>
<td>(1.23)</td>
<td>(1.75)</td>
<td></td>
</tr>
<tr>
<td>The infants' had just received a needle</td>
<td>6.41</td>
<td>7.73</td>
<td>6.49</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.63)</td>
<td>(2.75)</td>
<td>(3.18)</td>
<td></td>
</tr>
<tr>
<td>The infants' mood</td>
<td>7.71&lt;sup&gt;a&lt;/sup&gt;</td>
<td>7.78&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.32&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
<tr>
<td>The infants' body movements *</td>
<td>(2.88)</td>
<td>1.73</td>
<td>(2.48)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.99)</td>
<td>(3.30)</td>
<td>(3.22)</td>
<td></td>
</tr>
<tr>
<td>The infants were healthy</td>
<td>4.05</td>
<td>5.07</td>
<td>3.24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.99)</td>
<td>(3.30)</td>
<td>(3.22)</td>
<td></td>
</tr>
<tr>
<td>The infants' capacity to focus on their surroundings</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td></td>
</tr>
</tbody>
</table>

Note. Judgments were made on a 10-point scale (0 = Not Important, 5 = Moderately Important, 10 = Extremely Important). Dashes within table indicate cue did not meet criteria to be entered in the MANOVA analysis (at least one group with mean importance rating greater than 5). Means having the same superscript are not significantly different at p < .02 using the Tukey honestly significant difference comparison.

*Follow-up one-way ANOVA significant at p < .01
Table 12
MANOVA on Importance of Cues Ratings for 18 month olds: Means (and Standard Deviations)
for Follow-up Comparisons

<table>
<thead>
<tr>
<th>18 MONTHS</th>
<th>Parent</th>
<th>Nurse</th>
<th>Paediatrician</th>
</tr>
</thead>
<tbody>
<tr>
<td>The infants’ age</td>
<td>5.85 (3.90)</td>
<td>5.00 (3.53)</td>
<td>3.61 (3.06)</td>
</tr>
<tr>
<td>The infants’* Sounds</td>
<td>8.56&lt;sup&gt;a&lt;/sup&gt; (1.92)</td>
<td>7.76&lt;sup&gt;ab&lt;/sup&gt; (1.71)</td>
<td>6.90&lt;sup&gt;b&lt;/sup&gt; (2.29)</td>
</tr>
<tr>
<td>The infants’ capacity to understand pain</td>
<td>5.95 (3.40)</td>
<td>5.71 (3.32)</td>
<td>4.7805 (2.86)</td>
</tr>
<tr>
<td>The infants’ capacity to remember pain</td>
<td>5.61 (3.51)</td>
<td>5.61 (3.32)</td>
<td>4.00 (3.22)</td>
</tr>
<tr>
<td>The infants’ sizes</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>The infants were in a medical setting</td>
<td>5.00 (3.27)</td>
<td>5.29 (2.85)</td>
<td>4.07 (2.76)</td>
</tr>
<tr>
<td>The infants’ facial expressions</td>
<td>8.71 (1.91)</td>
<td>8.39 (1.50)</td>
<td>7.63 (2.11)</td>
</tr>
<tr>
<td>The infants’ had just received a needle</td>
<td>6.88 (3.49)</td>
<td>7.49 (2.90)</td>
<td>6.73 (3.15)</td>
</tr>
<tr>
<td>The infants’ mood</td>
<td>6.02 (3.42)</td>
<td>5.12 (2.87)</td>
<td>4.71 (2.49)</td>
</tr>
<tr>
<td>The infants’ body movements*</td>
<td>8.10&lt;sup&gt;a&lt;/sup&gt; (2.36)</td>
<td>7.54&lt;sup&gt;a&lt;/sup&gt; (2.19)</td>
<td>6.17&lt;sup&gt;b&lt;/sup&gt; (2.42)</td>
</tr>
<tr>
<td>The infants were healthy</td>
<td>4.63 (3.97)</td>
<td>5.18 (3.48)</td>
<td>3.05 (2.94)</td>
</tr>
<tr>
<td>The infants’ capacity to focus on their surroundings</td>
<td>5.71 (3.74)</td>
<td>5.39 (3.14)</td>
<td>4.59 (2.90)</td>
</tr>
</tbody>
</table>

Note. Judgments were made on a 10-point scale (0 = Not Important, 5 = Moderately Important, 10 = Extremely Important). Dashes within table indicate cue did not meet criteria to be entered in the MANOVA analysis (at least one sample with mean importance rating greater than 5). Means having the same superscript are not significantly different at p < .02 in the Tukey honestly significant difference comparison.

*Follow-up one-way ANOVA significant at p < .001
significant omnibus MANOVAs. For each group of follow up comparisons, a family-wise error rate of .10 was used for both the one-way ANOVAs and the Tukey’s post hoc comparisons. For both age group follow-up analyses, only the cues ‘sounds’ and ‘body movements’ were significantly different. Analyses for the 2 month olds indicated that the parents’ importance rating for ‘sounds’ was significantly greater than both the nurses’ and the paediatricians’ ratings, while the paediatricians’ importance rating of ‘body movements’ was significantly lower than the ratings of both parents’ and nurses’. Similar results were found for the importance ratings’ analyses for the 18 months old age group. The parents’ importance rating for ‘sounds’ was significantly greater than the paediatricians’ rating, but this time the nurses’ importance rating did not differ from either the paediatricians’ or the parents’ ratings. Finally, the paediatricians’ importance rating of ‘body movements’ was significantly lower than both parents’ and nurses’ ratings.

Importance ratings that optimally distinguish the groups: At both the 2 and 18 months old age levels, the importance ratings of all 12 cues were examined further as a set. Discriminant Function Analysis (DFA) is a procedure which sets out to find the dimension or dimensions along which groups differ. Each dimension can be referred to as a discriminant function. In applied terms, a discriminant function is a new variable that has been created from a set of variables optimally weighted to maximize discrimination between groups. Tables 13 and 14 present the discriminant function coefficients (variable weights) and group centroids (means on the discriminant function variable) for both the significant discriminant functions described below.
Table 13

**Discriminant Function Analyses of Importance Ratings of Cues: Standardized Discriminant Function Coefficients for Both Analyses**

<table>
<thead>
<tr>
<th></th>
<th>2 month olds</th>
<th>18 month olds</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DFA Coefficients</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>.586</td>
<td>.315</td>
</tr>
<tr>
<td><strong>Sounds</strong></td>
<td>.882</td>
<td>.332</td>
</tr>
<tr>
<td><strong>understand</strong></td>
<td>-.145</td>
<td>-.549</td>
</tr>
<tr>
<td><strong>remember</strong></td>
<td>.001</td>
<td>.491</td>
</tr>
<tr>
<td><strong>Sizes</strong></td>
<td>.300</td>
<td>.429</td>
</tr>
<tr>
<td><strong>Medical setting</strong></td>
<td>-.436</td>
<td>.150</td>
</tr>
<tr>
<td><strong>Facial expressions</strong></td>
<td>-.504</td>
<td>-.171</td>
</tr>
<tr>
<td><strong>Needle</strong></td>
<td>-.421</td>
<td>-.359</td>
</tr>
<tr>
<td><strong>Mood</strong></td>
<td>.174</td>
<td>-.386</td>
</tr>
<tr>
<td><strong>Body movements</strong></td>
<td>.232</td>
<td>.732</td>
</tr>
<tr>
<td><strong>Healthy surroundings</strong></td>
<td>.227</td>
<td>.370</td>
</tr>
<tr>
<td></td>
<td>-.223</td>
<td>-.125</td>
</tr>
</tbody>
</table>
Table 14

Group Centroids for the Primary Discriminant Function on Importance Ratings for 2 month olds and 18 month olds

<table>
<thead>
<tr>
<th></th>
<th>2 months old DF</th>
<th>18 months old DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents</td>
<td>.772</td>
<td>-.822</td>
</tr>
<tr>
<td>Nurses</td>
<td>-.244</td>
<td>.436</td>
</tr>
<tr>
<td>Paediatricians</td>
<td>-.503</td>
<td>.396</td>
</tr>
</tbody>
</table>

The DFA analysis for the 2 month olds, indicated that only the first discriminant function was significant ($\chi^2_{(24)} = 47.66, p < .003$). This chi-square statistic (and the parallel one for the 18 month old) offers redundant information to the aforementioned F-statistics reported for the MANOVAs on the importance ratings. The first discriminant function accounted for 63.8% of the total discrimination between the three groups. From analysing the discriminant function coefficients, it was deduced that the importance ratings of ‘sounds’, ‘age’, ‘medical setting’, ‘facial expression’ and the fact that ‘the infants had just received a needle’ were weighted most heavily in the discriminant function. Participants who scored higher on this discriminant function variable (in this case parents) tended to rate ‘sounds’ and ‘age’ of greater importance and ‘medical setting’, ‘facial expression’ and the fact ‘the infants had just received a needle’ of lesser importance. Examining the group centroids on the discriminant function demonstrates that this function reliably discriminates the parents from both the nurses and paediatricians. Thus even with optimal weighting, it appears that the nurses and paediatricians did not differ significantly in their importance ratings on the set of 12 cues used on infants that were 2 months old.
The DFA analysis for the 18 month olds, indicated that once again only the first discriminant function was significant ($\chi^2_{(24)} = 52.83, p < .001$). The first discriminant function accounted for 66.2% of the total discrimination between the groups. An examination of the discriminant function coefficients suggested that the importance rating of 'body movements', 'infants' ability to remember the pain', the 'infants' sizes', and 'the infants' ability to understand the pain' were key elements of the discriminant function. Participants who scored lowest on the discriminant function tended to rate the body movement, remembering and size cues as relatively less important and the understanding cue of higher importance. Examining the group centroids on the discriminant function shows that this function once again reliably discriminated the parents from the paediatricians and nurses. Thus at 18 months, we see that optimal weighting did not result in a notable difference between nurses’ and paediatricians importance ratings on the set of 12 cues but did distinguish both groups from the parents.

An examination of the results of both DFAs in tandem indicated that the distinction between parents and medical professionals was consistent at 2 and 18 months. The differences between the discriminant function co-efficients of the two discriminant functions also elucidate age group distinctions. At 2 months the discriminant function is based mostly on importance ratings of cues of objective environmental cues (i.e. sound, age, facial expression, needle and being in a medical setting) while at 18 months, more subjective cues requiring inference into the infants’ cognitive ability also contribute to optimal discrimination of the groups (i.e. remembering and understanding).
Analyses involving the Belief Statements

*Between-Group differences.* Each of the 10 belief statements for the 2 different infant ages under consideration (2 months, 18 months) were analyzed for proportional differences between the groups. The purpose of these chi-squares were to determine if the proportion of participants endorsing ‘true’, ‘false’ and ‘unsure’ differed between the three groups (parents, nurses, paediatricians). Using a family-wise alpha of .10 for the 10 chi-squares within an age group (.01 for each belief statement), no differences were found in the proportions of subjects endorsing true, false and unsure between the parents, nurses and paediatricians. Thus the three groups of judges were combined to form one large sample for the next set of analyses.

*Within-Age Group differences.* This analysis set out to determine if the proportion of subjects endorsing ‘true’ versus ‘false’ and ‘unsure’ (combined) differed between the 2 month olds and 18 month olds for each of the 10 belief statements. Given the proportions for the 2 month and 18 month olds were dependent (i.e. based on the same sample of judges), a special proportional test that is compared against the z-score distribution was utilized (McNemar, 1947). The test on the belief statement “Children of this age group can feel pain” was not warranted as 100% of the sample endorsed ‘true’ for both the 2 month and 18 month olds.

Utilizing a family-wise error rate of .10 (.01 for each test), only four belief statements had significant results, indicating a differential patterns of endorsement (‘true’ versus combination of ‘false’ and ‘unsure’) between the 2 month and 18 month old age levels (see Table 15 to 18).
### Table 15

**Frequency Table: “Children of this age group understand pain”**

<table>
<thead>
<tr>
<th></th>
<th>2 months</th>
<th></th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>False/Unsure</td>
<td>True</td>
<td></td>
</tr>
<tr>
<td>18 months</td>
<td>True</td>
<td>55</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>False/Unsure</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>76</td>
<td>47</td>
</tr>
</tbody>
</table>

*Note. z = -7.42, p < .00001*

### Table 16

**Frequency Table: “The setting a child of this age group is in can affect how much pain they feel”**

<table>
<thead>
<tr>
<th></th>
<th>2 months</th>
<th></th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>False/Unsure</td>
<td>True</td>
<td></td>
</tr>
<tr>
<td>18 months</td>
<td>True</td>
<td>44</td>
<td>51</td>
</tr>
<tr>
<td></td>
<td>False/Unsure</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td>70</td>
<td>53</td>
</tr>
</tbody>
</table>

*Note. z = -6.19, p < .00001*
Table 17

Frequency Table: "The mood of a child in this age group can affect how much pain they can feel"

<table>
<thead>
<tr>
<th></th>
<th>False/Unsure</th>
<th>True</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 months True</td>
<td>26</td>
<td>66</td>
<td>92</td>
</tr>
<tr>
<td>False/Unsure</td>
<td>30</td>
<td>1</td>
<td>31</td>
</tr>
<tr>
<td>TOTAL</td>
<td>56</td>
<td>67</td>
<td>N=123</td>
</tr>
</tbody>
</table>

Note. $z = -4.81$, $p < .00001$

Table 18

Frequency Table: "Children of this age group cannot remember pain"

<table>
<thead>
<tr>
<th></th>
<th>False/Unsure</th>
<th>True</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 months True</td>
<td>2</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>False/Unsure</td>
<td>91</td>
<td>24</td>
<td>115</td>
</tr>
<tr>
<td>TOTAL</td>
<td>93</td>
<td>30</td>
<td>N=123</td>
</tr>
</tbody>
</table>

Note. $z = 4.31$, $p < .00001$
These statements were "children of this age group understand pain" (z = -7.42, p < .00001), "the setting a child of this age group is in can affect how much pain they feel" (z = -6.19, p < .00001), "the mood of a child in this age group can affect how much pain they can feel" (z = -4.81, p < .00001) and "a child in this age group cannot remember pain" (z = 4.31, p < .00001).

Each of these significant chi-squares were in a direction indicating that the combined sample of judges believed that older children were more capable of cognitive processing (e.g. understanding, remembering and having mood or setting impact pain) than younger children.

Discussion

Infants, generally incapable of using verbal language to express their pain and very limited in their ability to modulate their own pain experience, are wholly dependent on their caregivers to acknowledge and alleviate their pain. The present study provided a comparative analysis of how different categories of infant caregivers attributed pain to an infant undergoing an acute pain stimulus. Cross-sample comparisons of cues self-reported to be important by different caregivers and the key beliefs held by these caregivers regarding infants of different ages were also conducted.

Demographic Differences

Preliminary analyses indicated that the sample of paediatricians was older and that between sample differences in terms of gender and parental status compositions existed. First, it is noteworthy that these sample differences actually reflected the population differences that exist among groups. For example, Haslam (2002) talks about
the current state of aging paediatricians in Canada, while societal norms indicate that
parents who have young infants tend to be in their twenties and thirties. Furthermore, in
terms of gender distributions, the facts that there were no male nurses employed in the
Special Care Nursery to recruit and that Statistics Canada (1996) noted that significantly
more adult females are engaged in the unpaid care of children than adult males also
validate these between group differences. Thus, these demographic differences between
categories of caregivers were seen as replicating the demographic characteristics of the
populations they were meant to reflect from the community.

Moreover, analyses conducted for each individual sample indicated that males versus
females and parents versus non-parents did not differ in their pain attributions. This
finding suggests that the between group differences discussed below were not simply due
to differences in the gender or parental status compositions of each sample. The lack of
gender differences replicated one study which also speculated that gender did not
contribute to between group differences between parents and health professionals on an
infant pain face recognition task (Balda, Guinsburg, Branco de Almeida, 2000).

The Creation of the Meta-Pain Variable.

The strong relationships between the VAS (numeric measure of pain intensity),
DDS-I (verbal descriptor measure of pain intensity) and DDS-U (verbal descriptor
measure of pain unpleasantness) parallel past work that demonstrated the concurrent
validity of these pain measures. Through the creation of the meta-pain variable, via a
PCA analysis, novel information is provided by the almost equal weighting of the three
variables. This type of weighting pattern strongly suggests that the three variables were
strongly related but not redundant. In regards to the two verbal descriptor scales, the
equivalent weighting adds further credibility to the conceptualization of pain as having related yet unique affective and sensory dimensions (e.g. Gracely & Dubner, 1987; Melzack & Katz, 1999). When examining the two sensory intensity scales, it is interesting to note that both these scales were also very closely weighted. Given they are both designed to measure a similar aspect of pain, that of intensity, one could speculate that it is the actual measurement modality that is the cause of their unique contributions to the meta-pain variable. One could hypothesize that unique information is garnered from judges when they are asked for pain ratings in terms of the relative placement of a mark between two anchors versus when they are asked for pain ratings in terms of selecting the most appropriate verbal descriptor.

Examination of the Judges’ Pain Ratings

The current investigation demonstrated that all judges believed the infants of all five age group experienced significant pain after an immunization injection. Given the meta-pain variable was scaled to parallel the mean and standard deviation of the VAS, guidelines for significant pain in regards to the VAS were considered relevant. Collins, Moore and McQuay, (1997) suggested that measurements of greater than 30 millimetres represents a clinically significant amount of pain. With substantially higher ratings (roughly 58 to 70 millimetres) and rare exception among any of the samples, it was re-assuring to find that almost every single judge believed that all the infants were undergoing a significant amount of pain.

However, further analysis of mean differences on the meta-pain variable suggested that subtle differences in pain attributions existed among the categories of caregivers and among the different ages of infants.
Why did paediatricians differ from parents but nurses not differ from either group? As an introductory caveat, it is important not to jump to conclusions about pain management based on between-sample differences in pain assessment. It is pertinent to recall that when asked directly “At what age do you believe children can experience pain”, the overwhelming majority of all three samples endorsed the “birth – 1 month” answer choice. However, the data did speak clearly to the fact that when provided with the exact same infant stimuli, paediatricians attributed significantly less pain to infants than parents, and nurses’ pain attributions fell between both parents’ and paediatricians’ rating. While common sense would suggest that pain management is strongly linked to pain assessment, whether these pain attribution differences would translate into between-group differences on action dispositions is speculative. It is noteworthy to also point out that when asked “At what age do you believe it is appropriate to begin to administer a pain-relieving medication?”, the paediatricians (the group with the lowest pain attribution) were almost unanimous in their choice of “birth – 1 month”, while one-third of the parents (the group with the highest pain attributions) selected an answer choice of greater than one month of age. This finding also partially confirmed the hypothesis that medical professionals would have pain beliefs more reflective of current infant pain research.

Initial hypotheses about the nature of pain attribution differences between the groups were also found to be partially correct. Parents and nurses did not differ in the amounts of pain they attributed to the infants. However, in contradiction to a priori hypotheses, paediatricians attributed less pain overall and did not differ from nurses.
Past work comparing samples in regards to beliefs and attributions of pain suggest different individual variables that may help explain these between group differences. Balda et al. (2000) and Prkachin & Craig (1995) reported correlational findings that the amount of formal education inversely related to the ability to sensitively detect pain faces. While data from the current analysis on pain attribution suggests some agreement with this finding (i.e. the paediatricians attributed less pain), it is speculated that this relationship is an artefact of the fact that the groups that spend the greatest amount of time with children tend to have the lower level of education. Paediatricians would have the most formal education but they also spend the least amount of time with an individual infant.

Craig, Grunau & Aquan-Assee (1988) speculated from their results that time spent with an infant would inversely relate to the amount of pain attributed to an infant. They suggested that individuals (in their study it was fathers) who are not used to seeing a child in pain may attribute higher levels of pain because they have little experience in which to comparatively judge the infant's distress. Although paediatricians spend less time with a particular infant, due to the number of paediatricians versus nurses and parents, they likely spend time with a higher number of infants in pain. Once again paralleling the pattern of pain attributions, one sees that when examining the three samples in terms of breadth of experience, parents would have the least amount of breadth while nurses would fall in-between the two other samples.

Secondary analyses on the importance ratings of cues used in pain attributions and the belief statements, also contribute to the discussion on between-group differences. At the coarsest level of analysis of the importance of cue ratings we see an interesting
pattern regarding the paediatricians. A simple tally of the number of cues rated as moderately important or greater for judgments of the 2 month olds revealed no differences between the three groups. Parents, nurses and paediatricians demonstrated remarkable similarity when rating ‘sounds’, ‘facial expressions’, ‘body movements’ and the fact that the infants “had just received a needle” of highest importance to their pain attributions of 2 month olds. However, when examining the tally of importance ratings of moderate importance or greater for 18 month olds, one notes a different pattern of importance ratings for paediatricians than for nurses and parents. Similar to their importance ratings for pain judgments of the 2 month olds, paediatricians rated the same four cues as important to their pain judgments for 18 month olds (sounds, facial expressions, body movements, just received a needle). However nurses and parents ended up rating 11 out of the 12 cues of moderate importance or greater. The most important cues rated by all categories of caregivers are consistent with other studies in the area that noted cry, facial activity, body movements are of crucial significance to pain attributions (e.g. Jones, 1989; Fuller, Thomson, Conner et al., 1996; Howard & Thurber, 1998). The finding that nurses and parents self-reported more cues for younger babies (than older babies) contradicts findings by Shapiro (1993) who found that no differences in cue utilization by nurses when they judged different ages of infants.

A deeper analysis of the cue importance ratings as a set (rather than a simple analysis of cues deemed important on a one by one basis), demonstrated that parents differed from nurses and paediatricians, regardless of whether discrimination analyses were performed on the set of importance ratings for the youngest or oldest babies. Thus when a discriminant function was created from ratings on the set of all 12 cues, it was
parents that consistently were different than both medical professionals. Furthermore when significant differences were found on the importance ratings of individual cues, paediatricians’ ratings were found to consistently differ from parents’ ratings. When examining the pattern of importance ratings for nurses (as a set and on individual cues), nurses’ importance ratings generally fell between the parents and paediatricians, paralleling findings on the meta-pain ratings. Finally, comparative analyses with the 10 belief statements indicated that the groups were homogeneous in regards to their beliefs about infant pain capabilities thus these particular analyses did not aid in elucidating between group differences.

At the micro level, current results examining between sample differences found that paediatricians attributed significantly less pain than parents, while nurses did not differ from either sample. Follow-up analyses suggested that the meta-pain rating differences between samples could be related to how the groups made their pain judgments. Consistent patterns of differences were found when looking at how the different groups prioritized cues used in their pain judgments. Consistently, parents were differentiated from nurses and paediatricians. When making judgments for the 2 month olds, it was found that parents tended to rate the cues ‘sounds’ and ‘age’ of greater importance and the cues relating to ‘medical setting’, ‘facial expression’ and the ‘needle’ of lesser importance, than both samples of medical professionals. For the 18 month old pain judgments, parents differentiated themselves from nurses and paediatricians by rating the cues relating to ‘body movements’, ‘infants’ remembering ability’, ‘infants’ sizes’ of lower importance and the cue relating to an ‘infants’ understanding ability’ as more important. Finally, the lack of differences found on the belief statements suggests
that between-group differences were not related to differing beliefs regarding infant capabilities when they are experiencing pain.

However at a more macro level of analysis, speculation is warranted about more general characteristics that distinguish the caregivers. The social perception literature has noted two important characteristics of a caregiver that impacts how they make judgments of infants. Emde (1993), in his synthesis of the major principles derived from the infant emotion attribution literature over the past three decades, noted that caregivers that are the most emotionally and physically available would be most sensitive to perceive the emotions of an infant. When discussing the concept of emotional availability, he noted that this translates into a caregiver who is both sensitive and responsive to an infant’s cues over time. This alludes to the idea that the actual quantity and quality of time spent with an infant is important because it allows one to build up an understanding of how an individual infant expresses emotion. It follows that emotional availability would be a function of how much time a caregiver spent with a particular infant.

Should this principle be applied to the context of attributing pain to an infant, one could predict that the category of caregivers who spent the most time with an infant would not only be most physically available but also be most emotionally available to judge the pain of an infant. The results of the pain ratings for this study follow this hypothesis quite well. Parents would spend the most time overall with a given infant (i.e. their own child). Should this infant require prolonged medical attention in a hospital setting, nurses would spend more time with this infant than any type of physician, but would spend less time overall with the infant, than the infant’s own parent. While the parents did not judge their own child, because they do not have a lot of experience
judging the pain of children not their own, they likely brought into the current judgment context experiences they garnered from their extended experiences with their own children.

Paediatricians and nurses however bring into the current judgment context a vast amount of experience in judging children that are not their own. One could speculate that it is these particular experiences (not the experiences of judging pain in their own children) that they are drawing from. In addition to broad pain judgment experiences with infants that are not their own, both nurses and paediatricians made the infant pain judgments for this study after years of professional medical training. Perhaps for the paediatricians it the combination of being to trained to assess and intervene with infants due to professional obligation (rather than purely emotional ties) and the repetitive exposure to many different infants in pain that resulted in a responding pattern whereby they attributed less pain to an individual infant. Other researchers have also suggested that an “institutional insensitivity”, resulting in the underassessment and undermanagement of infant pain, may occur due to the daily exposure to infants in pain (Balda et al., 2000; Craig, Korol and Pillai, 2002). Given nurses fall between both parents and paediatricians in terms of professional time spent with an infant and in terms of years of professional medical training, it also follows neatly that nurses did not differ from parents or paediatricians.

Why were older babies attributed more pain? As hypothesized, older babies were attributed more pain than younger babies. Shapiro (1993) found similar results in her sample comparing pre-term and full-term babies. Her research suggested that these differences occurred because caregivers utilize similar thresholds for pain cues in pre-
term and full-term infants. Given that pre-terms mount less vigorous responses in terms of cry, body movements, and facial activity (later verified by Craig, Whitfield, Grunau et al., 1993; Johnston & Stevens, 1996), using the same threshold would result in lower pain attributions for younger infants. However, in the current study with healthy infants of differing age groups, facial activity, cry and body movements were all presented such that all infants demonstrated a similar vigorous pain response.

In retrospect, only two aspects of the video stimulus could be seen as systemically varying with the age of the infant: the actual size of the infant (older infants were larger than younger infants) and the information regarding the age of the infant (constantly displayed in the corner of every video clip). However, when examining the self-reported importance ratings of “the infants’ size” to their pain judgment, this cue was the only cue (of the 12 cues provided) that was never rated of moderate importance or greater for any age group! The cue “an infant’s age” was also not deemed important by judges at 2 months, however at 18 months parents and nurses just barely rated the cue of moderate importance. Thus, according to their self-report, it does not appear that knowing the age of the infant or seeing the size of the infant was strongly contributing to the age group differences in pain ratings. Therefore further consideration of the current findings is required.

Revisiting analyses of the importance ratings, further information regarding the between age group differences is found. When comparing the importance ratings of individual cues between the 2 month and 18 month olds, it was found that the exact same cues (body movements and sounds) had similar significant differences between the samples. More specifically, despite parents, nurses and paediatricians rating ‘body
movements' and 'sounds' as important, parents tended to rate these as higher in importance than the medical professionals. Given this similar pattern was seen for both the importance ratings for the 2 month olds and 18 month olds, it is speculated that age group differences were likely not related to individual cue importance ratings. However, when the entire set of cue importance ratings was analyzed to optimize discrimination between groups, it was seen that the cues that were key in optimally discriminating the groups differed when the ratings were made for the 2 month olds versus the 18 month olds. With the younger babies, optimal discrimination were related to purely objective variables (i.e. age, sounds, facial expressions, and the fact the infants were in a medical setting) but with the older babies more subjective variables regarding the infants' cognitive ability (the infants' ability to understand, the infants' ability to remember) entered into the picture. Thus it appears that differing factors were involved with the optimal between-group discrimination at 2 month versus 18 month groups. The pattern of differences between what differentiates the groups at 2 months and 18 months may suggest that a key factor involved in between age group differences in pain attributions is the perceived cognitive ability of the infant.

Following this idea, it is interesting to note that when examining the responses to the belief statements, the issue of perceived differing cognitive ability between older and younger infants re-surfaced as a key issue. As aforementioned no between-sample differences were found; however, significant differences were found between age groups. Specifically, more participants agreed at 18 months (versus 2 months) that: infants were able to understand pain, infants were able to remember pain, infants' pain levels can be affected by not only their own mood and also the setting in which they experience the
pain. Examining all 10 belief statements, it was realized these four belief statements have a common theme. All four statements (in which significant age group differences were found) relate to an infant’s capability to cognitively process the pain experience. The differential pattern of judges’ responding for younger and older infants indicates that more participants are willing to attribute cognitive processing abilities to older infants than younger infants. Examining these results in light of the overall age group pain differences suggests that the attribution of more limited cognitive processing abilities to young infants could be one of the reasons why these infants were attributed less pain. This type of bias would be wholly consistent with past biases plaguing the literature asserting that the limited cognitive ability of infants precludes them from experiencing pain (described in Field, 1995; Derbyshire, 1996; Derbyshire, 1999). These results bolster previous speculations by Craig (1997) that perhaps pain in infancy has been neglected because caregivers do not believe young infants are cognitively mature enough to be conscious of pain.

Although it is not within the scope of the current study to answer this question, these findings provoke the query as to whether or not these cognitive capabilities are needed for an infant to experience pain. The current study found a connection between a reluctance to attribute cognitive processing abilities to infants and lower pain attributions; however, one could see how in fact the inverse would also be true. The ability to cognitively process the pain experience (or at least for caregivers to attribute cognitive processing abilities) could have logically also been linked to perceiving infants to have developed descending inhibitory pathways (as per Gate Control Theory these pathways help block pain transmission) and therefore lower levels of experienced pain. As a final
note, it is important to also recognize that many researchers have asserted (e.g. Anand & Hickey, 1987; Fitzgerald, 1991; Anand and Craig 1996; Taddio, Stevens, Craig et al., 1997) that an infant's cognitive processing capabilities at birth are developed enough to experience pain.

Thus, in summary, it was consistently found that infants of younger age groups were attributed significantly less pain than older infants. Analysis of contributing factors to this difference suggests that perhaps the reason younger infants are attributed less pain than older infants is because judges see them as less able to cognitively process the pain experience.

**Implications for Theory**

The Sociocommunication Model of Infant Pain postulates four interdependent stages in pain assessment and management (Prkachin & Craig, 1995; Craig, Lilley and Gilbert, 1996; Craig, Korol and Pillai, 2002). The current analyses build upon previous theory by elucidating details about the stage of Pain Assessment/Attribution. Overall, it was found that caregivers differ in the amount of pain they attribute to infants and that when caregivers attribute pain, they attribute significantly less pain to younger infants. Furthermore, by holding constant motor programs, the pain context and the caregiver's relationship to the child constant (i.e. other factors speculated by Craig et al., to impact pain experience and pain assessment), clear differences in beliefs were shown to neatly parallel the differences in pain attributions. This demonstrated empirically that caregiver beliefs play an important role within the stage of pain assessment/ attribution.

In regards to interpreting the results in terms of a heuristic framework, it is speculated that paediatricians appear to have a different heuristic strategy for judging
infants across ages than parents or nurses. Regardless of infant age, paediatricians rated the same four cues as important to their pain judgments. Nurses and parents, however, tended to have a different pattern in that the older the child, the more cues they rated as important. This suggests that if a pre-existing knowledge structure about what was important or crucial in determining pain was involved in their pain judgments (i.e. heuristic framework), by consistently rating the same four cues as important across age groups, paediatricians have a different heuristic structure than both nurses and parents.

On an added note, although the interaction between infant age and categories of caregivers was not found significant, an examination of the pain ratings does demonstrate a trend distinguishing paediatricians from nurses and parents. In a fashion more indicative of heuristic decision making, paediatricians showed less inter-age group variability on their pain judgments than either nurses or parents. While all three groups attributed more pain to older infants (thus a non-significant interaction between age and sample), a trend indicated that paediatricians did so to a lesser extent.

Implications for Clinical Practice.

**Statistical versus Clinical Significance** Although statistically significant differences were found, given the relatively small mean differences on the meta-pain rating, issues of the clinical significance of the results arise. Clinically significant differences in pain often relates to a patient's personal meanings for two different pain levels (Stevens & Gibbins, 2002; Powell, Kelly & Williams, 2001). For example, did the medication administered result in a significant difference to the patient’s report of pain (before and after medication)? However given the inability of an infant to communicate their personal meaning to different levels of pain, it becomes more difficult to determine
what constitutes a clinically significant difference in pain judgments. Anand (1998) discussed the idea of correlating differences in pain to the incidence of adverse events which may be a result of physiological changes caused by painful or stressful stimuli. However in terms of actual numerical differences on a pain scale, the data for infants are sparse and non-conclusive (Stevens & Gibbins, 2002).

Furthermore when looking at the larger picture of undermanaged infant pain, the current results offer little conclusive evidence regarding whether the differences among the different caregivers' attributions of pain, or the pain attributed by judges to different age groups would translate into differential action dispositions, such as an increased willingness to administer analgesics. Thus, a logical conundrum arises when trying to interpret the clinical significance of differences in pain attributions with no information relating to how a certain caregiver will act on that attribution to relieve an infant's pain.

This was a quasi-experimental design, utilizing video stimuli, interested in determining whether parents, paediatricians and nurses differed in regards to pain attributions and pain beliefs when presented with a similar judgment scenario. In terms of generalizations to the real world, results of this study indicate that when presented with a similar pain judgment context, paediatricians will attribute significantly less pain to healthy infants than parents, while nurses will not differ between the two groups.

Second, younger infants will be attributed significantly less pain than older infants. Given current speculations about the implications of unrelieved pain on plastic nervous systems (e.g. Anand, 1987; Fitzgerald, 1991; Taddio, Stevens, Craig et al., 1997), the current results suggest an area of grave concern. Younger infants, more vulnerable to long-term implications of unrelieved pain due to their developing (more plastic) nervous systems,
are actually in greater danger of having their pain undermanaged due to lower pain attributions.

Following up on the real world action dispositions that relate to both sets of differences in pain attributions is the next stage of research.

Suggestions for Future Research

Simon (1959) in his seminal paper "Theories of decision-making in economics and behavioural sciences" noted that it is important that for researchers to acknowledge that the decision-maker’s information about his/her environment is much less than an approximation to the real environment. He noted that when a decision-maker perceives the real world, they filter information. He declared that the “perceived world is fantastically different from the real world”. He goes on to assert that filtering is not merely a passive selection of some parts of a whole, but rather a full reconstruction of the environment. He states concisely, “the decision-maker’s model of the “real” world encompasses only a minute fraction of all the relevant characteristics of the real environment and his inferences extract only a minute fraction of all the information that is present even in his own model”. The current research study asked judges to self-report what was important to their pain judgments. In essence, asking them to meta-cognate about what they thought was important to their judgments of infants. The differences found herein were based on judges’ self-perception of what was integral to their pain judgments, not an objective method of determining what was actually important to the judges’ pain ratings. Determining whether or not they accurately reported what was important to their pain judgments, although an important area of research, was not a purpose of this study. Future research that manipulates the stimuli
presented to judges (depicting variations in cues such as level of facial action, cry, etc.) would be a valuable line of inquiry to determine how accurate judges are when self-reporting what was important to their pain judgments.

The results of this study strongly indicate that further research is warranted to determine the relationship between different caregivers' attributions of infant pain and the actions taken by caregivers to alleviate infant pain. Future research should venture out into real world clinical scenarios in which parents, nurses and paediatricians are involved in the assessment and management of infant pain. Although a study of this magnitude would be time-intensive and expensive, the strong patterns of results appear to justify further clarification of the implications of paediatricians attributing less amounts of pain and the impact of younger infants having less pain attributed to them. Both these different findings suggest possible reasons for the undermanagement of infant pain. It is especially worthwhile to note that paediatricians can be seen as an important source of pain medication and pain management information for parents and nurses. Therefore, these findings suggest possible areas of intervention to help improve the state of affairs for an infant in pain.

Limitations of the Study

The pattern of results arising from the current study should be interpreted in the context of the following caveats. First, due to the nature of a quasi-experimental design direct causative relationships between group membership and differences in pain ratings cannot be drawn. Given it is unconceivable that one could randomly assign individuals to parent, nurse or paediatrician groups, causative conclusions relating to group affiliation are elusive.
In order to pursue specific *a priori* hypotheses about the role beliefs play in relation to pain attributions, the study held constant different aspects that are involved with the attribution of pain to the infant. Thus parents were not related to the child they were asked to judge. It could be that kinship to a child one is judging would introduce more concern and sensitivity resulting in even higher pain judgments by parents. Or, another hypothesis is that given the pain judgment experience they brought into the current judgment context was the experience they have with their own children, parents’ pain ratings would not differ significantly from the results of this study.

Furthermore, judges did not interact with the infants they judged. Thus the influences of the reciprocal interactions between caregiver and infant were not factored into the analysis of infant pain experience and infant pain attributions. However given that one could speculate that paediatricians would be least influenced by reciprocal interactions with the child (as they objectively spend the least time with a given infant), it is hypothesized that when this is factored into the equation, this will serve to further discriminate them from parents and nurses in the direction found in this study.

Another issue that should be noted is that the samples were slightly different than what may be expected. First, the sample of parents was more highly educated than would be expected in a purely random sample of parents. Secondly, it could be argued that the nurses who work within the Special Care Nursery are qualitatively different than less specialized nurses because of their extended, daily exposure to critically ill infants. It is hypothesized that when the study is replicated in a real world clinical paradigm, having more variability in parental education, will not impact pain ratings because parents made their pain judgments based on their experience judging pain in their own children not
based on information they obtained through their formal education. Due to the need for a large sample size, nurses with predominantly infant interactions were obtained from a Special Care Nursery. It is speculated that involving nurses with less 'critically ill' infant experience (e.g. nurses at a local health unit) could result in lower pain ratings than that of this study because, similar to paediatricians, they would see more infants but have less time with an individual infant.

A caveat should be offered regarding the interpretation of the questionnaires designed to better understand how the judges made their pain judgments. Given the exploratory nature of work in the area examining what caregivers believe about infants in pain, two measures (The Cues Questionnaire and The Capabilities Questionnaire), were created based on relevant examples from infant judgment studies found in peer-reviewed journals. Regarding the Cues Questionnaire, when given the opportunity not one judge exercised the option to write in any additional cues suggesting that the provided cues list was comprehensive. Speaking further to the issue of basic content validity, the videoclips that were chosen for this study displayed infants that were behaviourally responsive (specifically those that were crying, showing a pain face and having other body movements suggestive of pain) to a needle. Given the videos were created with infants that were chosen because they demonstrated well-accepted indicators of infant pain, the convergent validity of the Cues Questionnaire is shown by having the cry, facial expression and body movement cues top the list of most important cues across age groups. Moreover, a limited degree of test-retest reliability of the Cues Questionnaire is also seen in the results. While the judgments were made in one session, multiple judgments of infants of different ages were made within that session. For each sample,
the top three cues for both younger and older infants stayed consistent in which cues were important (i.e. facial expressions, body movements, sounds) and which cues were not (e.g. infant’s ability to remember or understand the pain experience). A basic degree of content validity can also be seen with the results of the Capabilities Questionnaire. It is a widely acknowledged fact that, other conditions being equal, the older an infant the more able the infant is to cognitively process the environment. Given this fact, one would expect more judges to believe that older children were able to cognitively process the pain experience than younger children. Judge response trends on these questions (e.g. more caregivers agreed that older infants, as opposed to younger infants, were able to remember and understand pain) clearly parallel this well-known fact. Furthermore convergent validity is seen between the Cues and Capabilities Questionnaires. Recall results from the Cues Questionnaire indicating that the most important judgment cues (facial expression, cry and body movements) were the same for both younger and older age groups. Analyses on the Capabilities Questionnaire paralleled this finding. When comparing the proportions of judges who believed that infants can make sounds, body movements and facial expressions to indicate pain, there were no significant differences for younger and older infants. Due to the need for further work establishing the reliability and validity of these two measures, the information gathered from these two measures must not be overinterpreted. However, they do provide valuable fodder for further hypothesis generation.

Conclusions

Differences between how caregivers attribute pain across different ages has been speculated in the literature. Unfortunately, empirical knowledge has been mainly
confined to research on only one type of caregiver (nurses) and systematic investigations as to why pain attributions may differ between different groups of infant caregivers or different full-term infant age groups has been minimal. By conducting the first study to compare the pain attributions of three major categories of infant caregivers, this study builds on previously speculative research to demonstrate that indeed these groups do differ. Also by including infant age as a variable, a systematic age bias in pain attributions was replicated for a sampling of healthy infants. Furthermore, strong hypotheses regarding how attributions were made and the differential attributions of an infants’ cognitive ability were generated to explain both these between-sample and between-age group differences. This study serves as a strong justification to replicate and extend these results to real-world clinical paradigms. Thus by elucidating infant pain attribution differences between caregivers and age groups, the current study has achieved its overarching purpose to help determine factors responsible in the incidence of unrelieved infant pain.
References


Directions in Pediatric Pain Research. Presentation given at the 21st General Meeting of the American Pain Society, Baltimore, Maryland.


Stevens, B.J. & Gibbins, S. (2002). Clinical utility and clinical significance in the


Taddio, A., Stevens, B.J., Craig, K.D., Rastogi, P., Ben-David, S., Shennan, A.,


Informed Consent Form
The influence of consciousness attributions on the perception of infant pain

Principal Investigator: Dr. Kenneth D. Craig, Professor of Psychology.
Co-Investigators: Rebecca Pillai, MA
                     Doctoral Student, Clinical Psychology.

Purpose: The standards of infant pain management in Canada have improved in recent years. But there still remains substantial evidence of the under management of infant pain. The purpose of this study is to find out how doctors make judgements about infants' reactions to aversive stimuli.

Study Procedures: In the presence of a trained research assistant, participants will be asked to perform two tasks in their work offices. First, they will be asked to fill out questionnaires designed to provide background information about them and to give us information about how they make their judgements. Second, they will be asked to watch 20 video clips of infants (aged 2 months to 18 months) after the infants have received a routine immunization and rate how much hurt or pain they estimate the infant was feeling. The entire procedure is designed to take twenty minutes.

Confidentiality: Upon consenting to take part in this study, participants will be assigned an arbitrarily chosen code number. All documents will be only be identified by this number. Any subsequent analyses will utilize only documents bearing this code number. No participant will be identified in any subsequent reporting of information. All information will be kept in a locked filing cabinet. No risks are anticipated with taking part in this study.

Compensation: Participants will receive a delivered lunch consisting of a sandwich, juice or pop, piece of fruit and bag of potato chips.

Contact: If you have any questions or concerns with respect to this study, please contact Dr. Kenneth Craig, at . If you have any concerns about your treatment or rights as a research subject, please contact .

Doctors' Judgement Study Consent
Version 1- September 2001
ATTENTION ALL PARENTS!!!!!!!

HELP US HELP KIDS

THIS WEEK AT SCIENCE WORLD
UBC RESEARCHERS ARE CONDUCTING AN EXPERIMENT WITH PARENTS.

WHAT: Judging Videos

WHY: *You will be helping to alleviate needless pain in infants
*Your kids will get to participate in a fun learning activity, under supervision.
*The whole family will get to enjoy a 25% off coupon at the Science World White Spot.

WHEN: RIGHT NOW!!!!! (it'll only take 15 minutes)
Pain goes a long way real fast. Just Imagine: "ouches" from stubbing your big toe can run to your brain in less than a second! (actually tons less than a second) To see exactly where pain goes when you hurt your toe, help the OUCH get to Chuckie's brain so that he knows what's going on!!!!!

Stop #4: Until the pain is in the Brain. This is where we understand that what we're feeling is pain. Chuckie would now realize that kicking the rock hurts, and that it probably isn't the bestest thing to do with his time.

Stop #3: ...the pain uses the spinal cord highway... (if you put your hand on the middle part of your back you can feel it. It is the long boney thing that goes from your head to your bum!)

Stop #2: ...to the only road from our toe to our brain (the NERVES in our leg) then...

Stop # 1 : Pain goes by the PERIPHERAL NERVES... (lightening quick wires)

OUCH! Chuckie stubbed his toe!
WE NEED YOUR HELP!!!

UBC RESEARCHERS ARE CONDUCTING AN EXPERIMENT WITH ALL S.C.N. NURSES.

WHAT: Judging Videos of Infants after a needle.

WHY: *You will be helping us understand how nurses make pain judgements.
* We will present the results of our study and implications of our findings to interested nurses
*You will receive a FREE coffee and muffin coupon from the Hospital Cafeteria.

WHEN: Before or after your shift
(MAXIMUM TIME TO PARTICIPATE is ~20 minutes)
Dear Dr. Pediatrician:

For some years, my research program at the University of British Columbia has addressed the quality of care provided to infants and young children suffering from pain. This letter is a request for your participation in a study of pediatric pain that will require 20 minutes of your time, in your office, at any time during the day convenient to you.

My doctoral student (Rebecca Pillai) and I are interested in how various caregivers make judgements about infants’ reactions to invasive procedures. Two related studies looking at parent and nursing perceptions of infant pain have now been concluded and we are interested in the unique perceptions of pediatricians.

We would be asking you to complete brief questionnaires and to provide judgements concerning the videotaped reactions of infants to immunization injections. We will bring a portable TV/VCR to your office any weekday between 8:00 a.m. and 6:00 p.m. The information you provide would remain confidential, with the results of the study presented as aggregated information.

In compensation for your time, we will provide a delicious lunch to eat after participating in the study or a honourarium. If you or your assistant would call our lab, research assistant would confirm your preferred appointment time and arrange the details.

We do need a substantial participation rate and are keeping the demands on individual physicians minimal. If you have any questions concerning this study, please do not hesitate to contact me on my direct line.

Yours sincerely,

Kenneth D. Craig, Ph.D.
UBC Professor and
Canadian Institutes of Health Research
Senior Investigator

May 1, 2002
"We will now be showing you 20 short video clips of healthy (emphasize) infants videotaped directly after receiving a routine immunization needle at a local health unit. 4 infants will be aged approximately 2 months, 4 infants will be aged approximately 4 months, 4 infants will be aged approximately 6 months, 4 infants will be aged approximately 8 months and 4 infants will be aged approximately 18 months. They will be shown in a random order, but the age of each infant will be visible in the left hand corner of each video clip. After each clip we will ask you to estimate the pain you think that particular infant is feeling using 2 different rating scales. First, we'll have you to put a mark on the Visual Analog Scale (show scale) somewhere between the "no pain" side and the "worst pain possible" side. The second scale is a verbal descriptor scale (show scale). This scale asks you to rate the intensity of the infant's pain experience and the unpleasantness of the infant's pain experience. Just so you understand the difference between the unpleasantness and intensity scales I'm going to describe a radio metaphor. Suppose you like rock'n roll music, but not classical, and I liked classical music, but not rock 'n roll. And we both heard a radio that was blasting rock 'n roll, really loud. We both would rate the "intensity" of the sound as extremely intense. However, I might rate the sound as more "unpleasant" than you, since I dislike rock'n roll or put another way since you like rock and roll, you would not find it unpleasant but I would because I don't like rock and roll. Do you understand the difference?
The next step is that after every four babies, you will answer two forms based on how you made your judgements. Do you have any questions? Please do not turn the pages in your booklet, until I instruct you. Ready? Let's begin with a practice baby".
Participant Information Sheet

1. Your Current Age

2. Gender M F

3. Your Ethnic Background (circle one number)
   1. African
   2. Caucasian/white
   3. Asian (please specify)
   4. First Nations
   5. Other

4. Your Current Marital Status (circle one number):
   1. Married
   2. Divorced/Separated
   3. Remarried
   4. Widowed
   5. Never married
   6. Other

5. Your Education (circle one number):
   1. Graduate School/Professional Training
   2. University graduate (4 years college)
   3. Partial university (at least 1 year)
   4. Trade School/Community College
   5. High School Graduate
   6. Some high school (min. 10th grade)
   7. Junior high school graduate
   8. Less than 7th grade

6. a) Your Occupation (please describe)

   b) Does your occupation directly or indirectly deal with infants younger than 2 years old?
      No Yes, please describe:

   c) Have you ever taken any courses in infant development or care?
      No Yes, please list:

   d) Have you ever watched any movies/ tv shows or read any books on infant development or care?
      No Yes, please list:

   e) Aside from your own children, have you ever taken care of infants younger than 2 years old?
      No Yes, please describe the type of care and state for how long in months:
      1. e.g. Occasional babysitting how long? 2 years months
      2
      3
      4

Participant Number______________________
Appendix 8: Medical Experiences Questionnaire

Past Medical Experiences

1. Please indicate how many times you have experienced each of the following medical procedures:

<table>
<thead>
<tr>
<th>Medical Procedure</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throat Cultures:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Appointments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental Appointments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloodwork (finger poke and/or needles):</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalizations:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Please use a mark on the lines below to indicate the most pain you ever experienced from the following medical procedures:

<table>
<thead>
<tr>
<th>Medical Procedure</th>
<th>No Pain</th>
<th>Worst Pain Possible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throat Cultures:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical Appointments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dental Appointments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bloodwork (finger poke and/or needles):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospitalizations:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix 9: Developmental Beliefs Questions

1. At what age do you believe children experience pain similar to adults? (Please circle one of the age groups below)
   i) a) birth-1 month b) 1-4 months c) 4-8 months d) 8-12 months e) 12-18 months f) 18 months+
   ii) Use point form to briefly explain your age group choice:

2. At what age do you believe children can experience pain? (Please circle age group below)
   i) a) birth-1 month b) 1-4 months c) 4-8 months d) 8-12 months e) 12-18 months f) 18 months+
   ii) Please use point form to briefly explain your choice:

3. At what age do you believe it is appropriate to begin to administer a pain-relieving medication? (Please circle age group below)
   i) a) birth-1 month b) 1-4 months c) 4-8 months d) 8-12 months e) 12-18 months f) 18 months+
   ii) Please use point form to briefly explain your choice:

4. At what age do you believe children can experience pain as intensely as adults? (Please circle age group below)
   i) a) birth-1 month b) 1-4 months c) 4-8 months d) 8-12 months e) 12-18 months f) 18 months+
   ii) Please use point form to briefly explain your choice:
Appendix 10: Pain Intensity and Affect

Participant Number ____________________

1. Place a mark on the line to show how much pain you estimate the infant you just viewed was experiencing. There are no right or wrong answers.

No Pain .................................................. Worst Pain Possible

2. Please circle the highest level of pain Intensity and the highest level of pain Unpleasantness that you estimate the infant had experienced during the period you just watched. There are no right or wrong answers.

<table>
<thead>
<tr>
<th>Intensity</th>
<th>Unpleasantness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Extremely intense</td>
<td>A. Very intolerable</td>
</tr>
<tr>
<td>B. Very intense</td>
<td>B. Intolerable</td>
</tr>
<tr>
<td>C. Intense</td>
<td>C. Very distressing</td>
</tr>
<tr>
<td>D. Strong</td>
<td>D. Slightly intolerable</td>
</tr>
<tr>
<td>E. Slightly intense</td>
<td>E. Very annoying</td>
</tr>
<tr>
<td>F. Barely strong</td>
<td>F. Distressing</td>
</tr>
<tr>
<td>G. Moderate</td>
<td>G. Very unpleasant</td>
</tr>
<tr>
<td>H. Mild</td>
<td>H. Slightly distressing</td>
</tr>
<tr>
<td>I. Very mild</td>
<td>I. Annoying</td>
</tr>
<tr>
<td>J. Weak</td>
<td>J. Unpleasant</td>
</tr>
<tr>
<td>K. Very weak</td>
<td>K. Slightly annoying</td>
</tr>
<tr>
<td>L. Faint</td>
<td>L. Slightly unpleasant</td>
</tr>
<tr>
<td>M. No sensation of pain</td>
<td>M. No discomfort</td>
</tr>
</tbody>
</table>
Now that you have seen two videos and given your estimates of these infants’ pain, we are interested in your reasons for giving the pain estimate you did for this age group. Please read the following statements and decide whether you think the statement is mostly true (T) or false (F) for infants in the same age range that you have just judged.

1. Children of this age group can make sounds to indicate how much pain they are feeling
   T  F  Unsure

2. The physical size of children belonging to this age group affects how much pain they can feel
   T  F  Unsure

3. Children of this age group understand pain
   T  F  Unsure

4. The setting a child of this age group is in can affect how much pain they can feel
   T  F  Unsure

5. The expressions on the faces of children belonging to this age group can indicate how much pain they are feeling
   T  F  Unsure

6. Children of this age group can feel pain
   T  F  Unsure

7. The mood of a child in this age group can affect how much pain they can feel
   T  F  Unsure

8. A child in this age group cannot remember pain
   T  F  Unsure

9. The body movements of a child in this age group can indicate how much pain they are feeling
   T  F  Unsure

10. Certain medical procedures are more painful for adults, then they are for children of this age group
    T  F  Unsure
Appendix 12: Importance of Cues Questionnaire

Post Video 3

Participant Number

Now please rate the level of importance to your judgements of the infant’s pain, each of the following reasons had. If there was another reason you used to make your judgement, please list it below. The scale ranges from 0 (Not Important) to 10 (Extremely Important)

How important were the following reasons to your final ratings of pain for the infants of the age range that you have just judged...

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Important</td>
<td>Moderately Important</td>
<td>Extremely Important</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

List of Reasons

Rating of Importance (1-10)

The infants’ age ______________________
The infants’ sounds ______________________
The infants’ capacity to understand pain ______________________
The infants’ capacity to remember pain ______________________
The infants’ sizes ______________________
The infants’ were in a medical setting ______________________
The infants’ facial expressions ______________________
The infants had just received a needle ______________________
The infants’ mood ______________________
The infants’ body movements ______________________
The infants were healthy ______________________
The infants’ capacity to focus on their surroundings ______________________
Other: ______________________
Other: ______________________