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Editorial

New perspectives on the definition of pain

K.J.S. Anand*[a] and Kenneth D. Craig[b]

[a]*Department of Pediatrics, Anesthesia and Psychiatry, Emory University School of Medicine, Egleston Children's Hospital at Emory University, 1405 Clifton Road, NE, Atlanta, Georgia 30322 (USA) and* [b]*Department of Psychology, University of British Columbia, Vancouver, British Columbia (Canada)*

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Important advances have occurred in the study of pain after the I.A.S.P. Committee for Taxonomy defined pain as '*an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage*'. They further stated that '*pain is always subjective. Each individual learns the application of the word through experiences related to injury in early life*' (Merskey 1991).

Widespread acceptance of a definition of pain that focuses on pain perception has led, directly or indirectly, to many recent advances. Important classifications of pain syndromes, the framework for diagnostic categories, and the resultant search for effective treatments have benefited from defining pain as a subjective experience. Seminal advances in the mechanisms of chronic pain, pain modulation, its phenomenology, contextual influences, and novel therapeutic approaches would not have occurred if the definition of pain was limited by the occurrence of a proximate stimulus (Von Korff et al. 1992; Merskey and Bogduk 1994). Investigation of the widely variable neural elements and physiologic processes involved in the integration, processing, modulation of incoming nociceptive information at different levels of the CNS and within different time frames can also be related to the present definition (Anand and Carr 1989; Abram 1993).

In its present form, however, the definition of pain challenges our understanding of pain because it does not apply to living organisms that are incapable of self-report. This includes newborn and older infants, small children, mentally retarded, comatose, demented, or verbally handicapped individuals, and all primate and non-primate animals. For the purposes of this editorial, we will assume that the operational consequences of this definition are most evident in the clinical care given to neonates and small children. The acute distress experienced by infants undergoing tissue injury as a part of routine medical care is often neglected, discounted, and undertreated as compared to older children or adults (Anand and McGrath 1993a; Walco et al. 1994). Similar concerns apply to mentally retarded or handicapped adults (Biersdorff 1991, 1994), and the elderly suffering senile dementias (Hadjistavropoulos et al. submitted). We propose that the 'gold standard' of self-report necessary for the current identification of pain has several inherent weaknesses. We also propose that continued progress in pain research may involve a reconsideration of the definition of pain (Anand and McGrath 1993b).

Self-report is one component of the 'efferent response' to pain, which must first be preceded by its 'afferent component' or the actual experience of pain. In most instances, feeling pain and reporting pain are related and sequential events, although their congruence cannot be guaranteed for any individual pain experience (Prkachin and Craig, 1995). The current definition of pain relies greatly on the assumption of congruence or direct association. Inferring subjective experiences from self-report can be hazardous because of responses biases and situational influences. Relationships between *feeling pain* and *reporting pain* are highly context-dependent. They reflect who is eliciting the self-report, the methods used to assess pain (e.g. interview or scaled psychometric instrument), the underlying reasons for eliciting the description of pain (e.g. intramuscular injection vs. maternal comforting), and the individual's perception of the consequences of reporting pain. Major discrepancies have been observed among self-report, nonverbal expression, and the manifest evidence of tissue damage, reflecting the impact of some of these variables, in children (Manne et al. 1992; Doherty et al. 1993) and in adults (Craig et al. 1992). Because self-report may be absent or a faulty source of inference, nonverbal behavioral information is often needed and used for pain assessment (Craig 1993).

* *Corresponding author*: K.J.S. Anand, Egleston Children's Hospital at Emory University, 1405 Clifton Road, NE, Atlanta, Georgia 30322, USA. Tel.: (404) 315 2556; Fax: (404) 325 6233.

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This definition further states that use of the word 'pain' needs to be learned through experiences in early life. We submit that the perception of pain (whether associated with tissue damage or not) is an inherent quality of life itself, is expressed in all viable living organisms, and, while subject to influence by life experiences, does not require prior experience in the first instance. As the primary sensation that guards against damage to the organism from its external or internal environment, the experience of pain need not be based on any prior experience of it. The first experience of tissue injury is painful, in much the same way that touch, smell, vision, or hearing need not be learned in order to occur in the human organism. However, the interpretation and meaning of these sensations will develop with experience through positive, negative, and contextual associations. At the risk of being provocative, we suggest that memory and learning cannot be separated from the behaving organism. As the body develops, so do its behavioral repertoire and the qualitative features of its subjective experiences. As properties of a behaving organism, learning and memory are incorporated into experience as components of ontogenetic adaptation.

Ontogenetic adaptation to the demands of the environment, including the capacity to effectively communicate needs, is crucial for the organism's survival. Evidence for ontogenetic adaptation is available from studies of fetal behavior (Robinson and Smotherman 1992) as well as postnatal behavior. For example, within 3 days after birth, newborn infants will focus for longer periods on a projection of their mother's face relative to that of a woman matched for facial similarity and lactational status, or other generic facies (Bushnell et al. 1983). Six-day-old newborns have learnt to recognize the smell of their mother's breast over that of a similarly lactating stranger (Porter and Moore 1981). Ample data from animal studies corroborate these findings, confirming that the sensations of smell or vision do not depend on prior experience. The 'interpretation' of these sensory experiences is mediated through association and the affective impact of other experiences that are contiguous with a particular smell or sight. This form of learning is a component of the ontogenetic adaptation required to maintain nutrition and ensure survival. Experimental manipulations of this process in newborn animals have drastic behavioral consequences in later life (Fillion and Blass 1986; Kaplan et al. 1977). In a similar manner, recent findings suggest that exposure to substantial pain in early life transforms the nature of the pain experience and its expression later in childhood (Grunau et al. 1994; Taddio et al. 1995; Gunnar et al. 1995). Further, the behavioral responses of preterm neonates to heelstick pain were correlated with their previous experience of painful events between 28 and 32 weeks of gestation (Johnston and Stevens 1996).

In his book titled '*The Expression of the Emotions in Man and Animals*', Darwin (1872) argued that those emotions that are most necessary for survival are the first to appear in development and evolution. The signalling of hunger and tissue damage are obviously the most necessary emotions for survival of the newly born, and therefore will appear earlier than any other adaptational behaviors during development. The idea of ontogenetic adaptation further suggests that each stage in developmental process is an essential whole (a form of completeness) in itself, rather than a series of successive approximations of the final adult form. The reaction pattern represents an optimal adaptation for the organism at that moment in time. This contrasts with the traditional view that developmental traits are primarily precursors of adult characteristics (Oppenheim 1984). We propose, therefore, that each developmental stage of the pain system has completeness in itself, such that it allows a viable organism to perceive and respond to the inherent dangers of tissue injury. Basing the existence of pain on the ability of self-report (strictly defined within the capabilities of adult interpretation), would only serve to deny the important biological and behavioral roles for the modality of pain, as well as similar roles for the pain system within the living organism.

What is the evidence, therefore, that newborns perceive and respond to tissue injury in a similar manner as has been labelled pain in the more mature organism? Much of this evidence has been reviewed from mechanistic (Anand and Hickey 1987; Fitzgerald 1991; Fitzgerald and Anand 1993; Fitzgerald and Andrews 1996) and behavioral points of view (Craig and Grunau, 1993; Johnston et al. 1993; Stevens et al. 1994), although a more 'holistic' interpretation of this evidence may help integrate it within the biobehavioral milieu of infantile existence. Thus, studies in newborn rat pups indicate that they actively respond to painful stimuli immediately after birth (McLaughlin et al. 1990; Guy and Abbott 1992), even before the modalities of vision (fused eyes) or hearing (poor response to ultrasonic stimuli in the 30–50 kHz range) are completely functional. These behavioral events are associated with the activation of spinal and supraspinal neurons (Yi and Barr 1995; Anand and Plotsky, unpublished data) in areas and patterns classically associated with the processing of painful stimuli.

Such evidence suggests that the sensation of pain requires no prior experience, and appears early in ontogeny in order to serve as a signalling system for tissue damage. Human fetuses mounted hormonal responses to painful stimuli delivered in utero, which were similar to the hormonal responses of preterm neonates or older children experiencing such stimuli (Giannakoulopoulos et al. 1994). The biological and behavioral reactions to pain are evident not only in term neonates, but also in extremely premature newborns (Craig et al. 1993; Fitzgerald 1991), indicating the experience of pain by all

viable newborns. The distress expressed by newborns and infants on the occasion of a first heelprick or needle injection is strikingly evident to observers (Hadjistavropoulos et al. 1994), whether parent or clinician, although this evidence is commonly denied or misinterpreted. The fact that the neonate's expression of unpleasantness does not fit within the strict definition of pain (imposed by the requirements for self-report) contributes to the failure to recognize and aggressively treat pain in infancy and early childhood.

Contrary to traditional interpretations, we propose that the behavioral alterations caused by pain are the infantile forms of self-report and should not be discounted as 'surrogate measures' of pain. The nature of these behavioral alterations depends on the repertoire associated with each developmental stage, and has meaning within the biobehavioral milieu of the newborn infant and in all succeeding epochs of life. Attention to the communicational specificity of these biobehavioral response patterns during painful events would reduce barriers to optimal pain management in infants and young children (Craig et al. 1996). Management of pain would then be the consequence of actually recognizing its presence rather than based on compassionate feelings or ethical arguments (Walco et al. 1994).

Pain assessment must be designed to conform to the communication capabilities of the suffering person, whether infant, verbal child, effectual adult, or incompetent adult. The onus should be on scientists and clinicians to develop and implement a definition of pain that applies not only to those individuals whose communicative skills conform to the expectations and capabilities of investigators, but also to those diverse, special populations that communicate in a unique and effective manner through their biobehavioral responses. If the afferent component of this subjective experience is endorsed by all scientists and clinicians, a natural consequence would be the development of novel approaches to its measurement, assessment, management, clinical and biological importance.

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