

## **Memorandum 4**

### **Submission from Dr Stuart Derbyshire, University of Birmingham, School of Psychology**

#### **Evidence regarding the development of fetal pain**

##### **Executive summary**

The issue of fetal pain is divided into two component parts: the first addresses the developing neurobiology of the fetus and the second the developmental psychology of pain. With regards to neurobiology, there are a series of important points in development that may be relevant to pain processing. New features have been observed at 7, 18 and 26 weeks gestation and used to suggest an experience of pain *in utero*. These new features are tremendously interesting, and exciting, but they do not tell us that the fetus is capable of pain experience. Subjective experience, including pain, cannot be inferred from measures of anatomy, stress hormones and fetal movements because these measures do not account for the contents of experience in general, and of pain in particular. Before an infant can think about objects or events, or experience sensations and emotion, the elements of thought must have their own independent existence in the infant's mind. This is something that is achieved via continued brain development in conjunction with discoveries made in action and in patterns of adjustment and interaction with the infant's caregiver. We can be confident that the fetus does not experience pain because the developmental processes necessary for experience are not yet developed. Consequently, anaesthetic intervention during abortion is unnecessary and discussion of fetal pain with women seeking a termination unhelpful. Nevertheless, absence of fetal pain does not resolve the question of whether abortion is morally acceptable or should be legal.

##### **About the author**

The author has been actively involved in the use of brain imaging techniques since these techniques were first applied to the assessment of pain in 1991. He has a particular interest

in the relation of biological measurements to psychological experience and has consequently contributed to debate on fetal pain. These contributions have included published reviews in the British Medical Journal, the journal Bioethics and the journals of the International Association for the Study of Pain and the American Pain Society as well as oral testimony before UK and USA Government and scientific bodies. The author is a member of the International Association for the Study of Pain and the American Pain Society.

1. This paper examines two main issues: first the neurobiology of the fetus and second the difficulty of bringing together the biological development of the fetus with the notion of fetal pain. On the first, the key point is that there are a series of important moments in development that may be relevant to pain processing. Fetal development is continuous, of course, but new features have been observed at 7, 18 and 26 weeks gestation and have been used to suggest an experience of pain *in utero*. These new features are tremendously interesting, and exciting, but they do not tell us that the fetus is sentient. It is a mistake to try and read off experience, including pain, from measures of anatomy, stress hormones and fetal movements, because this approach fails to account for the contents of awareness in general, and of pain in particular.

#### **A. The neurobiology of a fetus.**

2. Although the analogy is quite oversimplified, it is not unreasonable to think of pain as being similar to a fire alarm. The pain stimulus is the same as hitting the red button, the electric cable to the alarm is the same as the connection between nerve endings and the brain and the alarm itself is the brain ringing out pain. Answering the question of whether the fetus feels pain can then be answered, in part, by considering the development of this 'alarm' system.
3. First, the 'alarm buttons': Fetal skin contains free nerve endings, naked nerve endings that lie free in the skin, responsible for initial registration of noxious

stimulation. Although these begin to form from about 7 weeks gestation, these cells do not mature until 24-28 weeks gestation. The spinal cord, the major “cable” from the “buttons” to the brain, also does not mature until around 24-28 weeks.

4. Some projections from the immature spinal cord reach the thalamus (the lower ‘alarm’) of the brain at about 7 weeks gestation but at 7 weeks the nervous system is very immature. It is not yet ready to ‘ring’. There is little indication of the cell structure and mature organization of the spinal cord, thalamus or cortex, which will gradually appear from around 20 weeks gestation.
5. The very first projections from the thalamus towards the cortex (the higher ‘alarm’) are apparent from about 12-16 weeks gestation but these are projections into the subplate. The subplate is a ‘waiting compartment’ where fibers accumulate and mature before penetrating the cortical plate developing above. Like waiting in the lobby of a theatre or stadium, interactions are random, and uncoordinated, until direction towards a seat is provided.
6. From 18 weeks, studies have demonstrated that the fetus can launch a ‘stress response’ to invasive procedures including increased production of cortisol and  $\beta$ -endorphin. Other defensive reactions, such as the redistribution of blood towards vital organs, have also been described. These reactions are indicative of a maturing brain and nervous system, reflected in the anatomical changes described. It is noteworthy, however, that these haemodynamic changes and changes in cortisol and endorphins are elicited at the subcortical and brainstem level and do not require cortical input and thus do not provide evidence for pain experience. Cortisol and endorphin are significantly elevated during surgical procedures carried out under general anesthesia, and in brain dead patients during organ harvesting, despite cortical activation in these patients being profoundly suppressed.

7. Thalamic connections do not penetrate the cortical plate, making it to their 'seats', until 26 weeks gestation. The 'alarm' has now been built to ring though with considerable development of its 'ringing' ability yet to be realized.
8. Starting at 28 weeks there is massive relocation of subplate fibers into the cortical plate. Even after that point the cortical plate undergoes tremendous growth increasing in volume by 50% between 29 weeks and term when the characteristic layers, the 'seat ordering', of the cortex appear.
9. There can be no question that fetal development is both rapid and amazing but there is equally no question that the fetus is immature. The cell structure of the immature brain differs from that of a mature one to a considerable extent and the fetal brain has a number of prominent structures that are transient in nature. For example, the thalamic reticular nucleus, which is attached to the side of the thalamus, appears as inconspicuous in the adult human brain but is very prominent in the fetal brain. In the fetal brain, this reticular nucleus is characterized by a high packing density of neurons, which undergo cell death after birth. These cells are likely involved in the regulation of developmental events in the womb that become unnecessary after birth.
10. One function of such cells could be to suppress fetal arousal through inhibition of thalamocortical activation. Suppression of fetal arousal in the womb is also known to involve placental inhibitory factors, such as adenosine, and other neurotransmitters, peptides and endocrine factors as well as the warmth, buoyancy and cushioned tactile environment provided by the womb. The intense tactile stimulation during labor, and the subsequent separation of the baby from the placenta and umbilical cord, facilitates the usually rapid onset of behavioral activity and wakefulness in newborn human infants. The function of some neurotransmitters and hormones will

switch at this point and the structure of the brain will begin a new phase of change and development – often as rapid and as impressive as changes during the fetal period.

11. To summarize this section on the structure and function of the fetal brain: while it is obviously true that the fetus undergoes tremendous development from conception to birth, extrapolation from the mature to immature brain and even from the post natal environment to the womb are bound to be approximate and often mistaken.

### **B. The difficulty of bringing the fetus and pain together.**

12. To a large extent, however, the biological development of the fetus is beside the point because the mere presence of anatomical structures, neurochemicals, hormones, and so on, is insufficient for experience, including that of pain.

13. Pain is not merely the response to physical injury or disease but is a higher order experience including emotional, cognitive (thinking) and sensory components. It is not something that we experience raw and then interpret post-hoc. The interpretation is the experience. Distinguishing sensations from thoughts, emotions, or each other requires a conceptual basis on which the distinction is drawn. We easily forget that this conceptual basis is needed and view brain development as merely about hooking 'alarms' up to 'buttons', forgetting that it is also about enabling subjective experience.

14. At birth and afterwards there is a massive increase in sensory input and this acts as a form of 'neuronal crowd control'. Repeated sensory input during this critical period of development results in generation and stabilization of functional brain circuits with unused pathways being eliminated. This internal organization of inputs helps the

differentiation and creation of feeling so that the feeling of hunger, for example, can be separated from feelings of cold.

15. Prior to this organization everything will arrive at the senses in an undifferentiated form, like looking at a vast TV screen with the world's information upon it from a distance of two centimeters. A great buzzing mass of meaningless information. What needs to happen before an infant can think about objects or events, or experience sensations and emotion, is that the elements of thought must have their own independent existence in the infant's mind. This is something that is achieved post-birth both via continued brain development and through discoveries made in action and in patterns of mutual adjustment and interaction between infant and caregiver. Changes in frontal cortex activity, for example, come at a time when cognitively related behaviors, such as the phenomenon of stranger anxiety and improvements in memory begin to appear. Similarly the first coordinated motor movements require the further development of specialized motor regions of the brain. Gradual improvements in motor, visual, spatial and sensory integration mark the disappearance of reflex neonatal behaviors and the emergence of higher conscious function, which will include pain.

16. The development of representational memory, which allows an infant to respond and learn based upon stored information rather than upon the basis of material directly available, may be considered a building block, if not a cornerstone, of conscious development. This function begins to emerge between 2 and 4 months of age. From now on there is the possibility of tagging in memory, or labeling as a 'something', all the objects, emotions and sensations that appear or are felt. As the infant develops, identifies with others, and is affected by their reactions, so her behavior becomes increasingly guided by the push and pull of her inside and outside world until the two

become intertwined allowing understanding and thinking to flourish. When this happens, everything is changed.

17. Concepts, thought and language now become possible. Language plays a particularly important role because it is largely through language that true concepts or thoughts can arise as words, or other symbols, are used to encompass those thoughts. Language quite probably slots into those patterns of interaction and mutual adjustment between infant and caregiver that have been well practiced for many months. But now language allows for a level of distinction and refinement in thinking that would otherwise not be possible. To have and to use a concept, one needs to have it and use it consistently and appropriately. I cannot privately point to an object or identify an emotion and expect to gain reliable information. To reliably discriminate the world, one needs to be able to check that the concept is being used correctly and not at whim. For this, one needs a way of checking and it is here that other people and language come into the picture.

18. Subjective experience might feel entirely natural and private but this is mistaken. The content of our mind becomes meaningful to us only in so far as it is meaningful to others and is the consequence of a developmental process that is social as well as natural. If pain, for example, were an entirely private affair, no words would be able to express it because no external frame of reference would be comparable and therefore adequate to express the sensation. Pain is not like this because clearly people do express their painful experiences and these expressions have meaning that allow for diagnosis, treatment and eradication of pain. The expressions of pain are meaningful because they are attached to publicly accessible conditions that warrant their application. If we were trapped inside our own heads, we would be unable to know whether what one person states as 'pain' is the same as someone else's 'pain'. Indeed we would not know if any internal state of our own were the

same or different from any other and, as it would not be possible to distinguish any state from any other, no state would consequently exist. This is not to deny that the neonate and fetus has the neural apparatus to discriminate information; clearly the fetus and neonate do not respond to tactile stimuli in the same way as to visual stimuli, for example. Indeed, this discriminatory processing is the raw material for a primary caretaker's assessments of need and for the interactions and behavioral adjustments that will occur in the forthcoming months. But it is to deny that there is experiential discrimination and, therefore, that there is experience at all.

19. Conscious experience only begins as objects, events and emotions become a focus between the infant and caregiver. Discoveries are made first in mutually coordinated actions and feelings rather than in thought. In so far as human beings live in a community of thinking, feeling, talking beings these things that happen between people then become things that happen within the individual's own mind and the privacy of experience is broken down and externalized for further analysis. As we are able to externalize our inner world so we are able to reflect upon that world and become self aware or self-conscious. Consciousness *is* self-consciousness, one cannot reflect upon the world without knowing that it is I who am reflecting. If we were not conscious of being conscious, then we would be unconscious of consciousness, which is an absurdity. It is social development and language that make this conscious awareness possible; symbolic representation does not teach an infant to recognize differences that were always there it teaches them to create differences where none previously existed. This, of course, sounds very strange – We instinctively want something, such as neuroanatomical features or pain behavior, to be the disinterested representation of the pain sensation. We are constantly trying to strip off the social elements of the pain experience to get at its true biomedical core but we have no access to this core pain sensation; it simply does not exist within the bounds of our awareness. It is only with content that experience becomes realized and



content is not natural. The temporal, sensorial, affective and cognitive features of pain are things that we spend a great deal of our development learning.

20. Language plays a particularly important role, not by giving voice to experiences already available and fully formed inside our heads, but by creating those subjective experiences through making the quality of those experiences apparent to us, by giving them a structure, by placing them within more abstract categories of thought and by linking them to external reference and social convention. Clearly our access to others' pain is mediated through behavior and language but this is also true of our own pain experience. Social development structures our behavior and language so as to be meaningful to the outside world but with the unnoticed side effect of rendering the child's inner experience meaningful to him or her. While brain development is certainly a necessary precursor of conscious sensory awareness, merely peering inside the head will not reveal the source of awareness.

21. This is how we can be so positive that the fetus is not conscious and, therefore, cannot experience pain. Not only has the biological development not yet occurred but also the post-birth environment, so necessary to the development of experience, has not yet made itself felt. In short, fetal pain is a moral blunder based on the false equivalence between observer and observed that misses the whole point and process of development.

22. One final point in conclusion. Regardless of what we can prove, or what we believe, about fetal capabilities, there will never be a fetalometer to tell us whether an act of violence against the fetus is right or wrong. Abortion is a legal question, a political question and a moral question but it is not a scientific question. Consequently it needs to be decided at the level of society and morality and not with science.

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