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Submission to the Queensland Child Protection Commission of Inquiry

**Crucial insights about abused and neglected children: findings from the neurobiological revolution.**

This is a brief submission to ensure the Inquiry is aware of what the current 'neurobiological revolution' is telling us about the immediate and longer term biological effects of an infant, child or adolescent's experience of prejudicial parenting and/or frank abuse of various kinds. By 'neurobiological revolution' I refer to technological advances that have occurred over the last 1-2 decades that have allowed a comprehensive systems biology approach to investigating illness and the effects of the environment on human functioning. Advances include better anatomical definition with the use of MRI; understanding brain functioning with functional MRI (e.g. what parts of the brain are involved in activities such as emotion, fear, thinking); the decoding of the human genome - including our ability to do this faster and cheaper; and molecular techniques that can investigate specific chemical pathways. Systems biology is a comprehensive investigative approach that, at the same time, applies these new technologies to any given search question: looking at gene type, gene programming (epigenetics), the function of intracellular messenger systems, the proteins subsequently produced (proteomics), and brought together with powerful new statistical analyses (bioinformatics).

Issues relevant to child protection include: (1) evidence of structural brain damage in abused children - including early evidence of differential damage by type of abuse and by critical periods, (2) evidence of parenting effecting gene programming, and (3) evidence explaining how trauma-related biological functioning is passed on between generations (4) evidence that adverse childhood experiences also has a profound effect on later physical health. Conclusions will highlight how this new knowledge informs clinicians and service providers.

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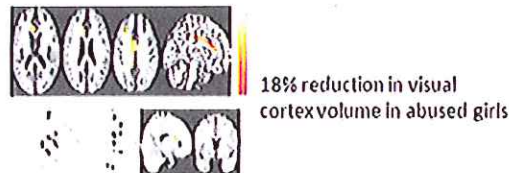
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(1) Evidence of structural brain damage.

A highly regarded research group from Harvard University (USA) and Fukui University (Japan) have collaborated to perform MRI studies comparing young adult women with abuse histories and non-abused age matched controls. Their findings have been published in first rank peer-reviewed scientific journals. Figure I (ref Tomoda) highlights young women who have abuse histories as a child have on average an 18% reduction in the volume of their visual cortex. Important background is the greatest period of expansion of brain inter-connectivity is during the last trimester of pregnancy and the first 2 months of life. Whilst later organisation and new neuron-neuron connections can occur during adolescence, the earlier in life visual cortex volume loss seen in these young women occurs, the more likely this damage will be permanent.

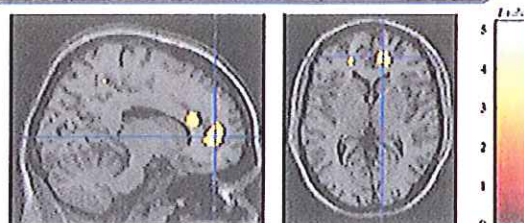
Figure I: Type II trauma and brain structure



Childhood Sexual Abuse is Associated with Reduced Gray Matter Volume in Visual Cortex of Young Women.  
Visual cortex and childhood abuse Tomoda A et al, 2009

This group has also researched structural brain changes relating to other types of abuse. Figure II notes a statistically significant decrease in volume in a frontal lobe region important in executive functioning and reasoned decision making in young adults who experienced physical abuse as children.

Figure II: site of damage type is abuse dependent

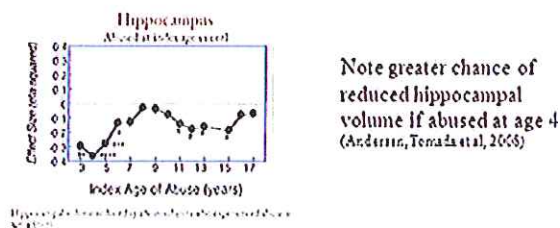


Reduced prefrontal cortical gray matter volume in young adults exposed to harsh corporal punishment

Ref: Tomoda A et al, 2009

Figure III graphically depicts statistically significant loss of volume in the hippocampus - an area crucial to emotional regulation, in young adults who experienced serious verbal abuse as a child. Note the abused group were 'under the normal value' for much of their child and adolescent developmental period. However, the difference with a control group was very significant if this occurred around the time of 4 years of age. It may be that these neurobiological changes are more likely at critical periods. From a developmental perspective these early ages are times when young children need to learn to regulate their emotions and behavioural to conform with expectations. It seems intuitive, and in agreement with this research, that abuse at this time may be particularly damaging.

**Figure III: Damage and critical periods**



## (2) Evidence of parenting effecting gene functioning

The group at McGill University (Canada), led by Michael Meaney and Moshe Szyf, have provided compelling evidence that the 'central dogma' of genetics: the linear relationship between our DNA (genes) are read by RNA (transcription) which turns on protein production, is in fact incorrect. Rather this system is dynamic in that we now understand the speed and efficiency of this gene information-control system can be altered by parenting and exposure to early abuse. In other words genes can be encouraged to work more quickly and efficiently, or more slowly. Key findings include good parenting leads to a process that makes DNA more easily read (by the de-methylation of a key control protein), which in turn makes the system work faster. The ground breaking work of Meaney has demonstrated altered gene function leading to a faster, more adaptive stress response that is biological mediated in a better parented group. Szyf's work found these methylation patterns clearly separated 35 year old males who committed suicide between those with past abuse and those non-abused. Similarly, looking at gene methylation patterns in a major longitudinal study (the 1958 British Birth cohort), the methylation pattern of abuse individuals clearly differed from those with the experience of abuse, poverty in early life and those who experienced neither abuse nor poverty. This ability of the genome to be up and down regulated is termed the gene programming and whilst it can be altered later in life, it is usually established early. It is one biological mechanism for continuing the damage of early abusive experiences long after the abuse has ceased.

### (3) Evidence of passing on abuse experiences across generations

The usually cited mechanism for trans-generational passage of adversity was through a psychological process such as limited experience of consistent parenting as a child, therefore demonstrating parenting deficits when an adult. Other possibilities include poor regulation of mood, impulses and behaviour because of sexual or physical abuse and then modelling these attributes to the next generation of children. Yehuda, working with women pregnant during the 9/11 tragedy in New York, and in separate studies of the children of holocaust survivors has demonstrated this epigenetic - gene programming mechanism is passed on between generations. The implication is that abused children, by the nature of their experience and subsequent methylation of their genome, are more likely to give birth to children with the same gene methylation pattern and associated dys-regulated stress systems.

### (4) Evidence of the effects of abuse on adult physical illness

The seminal study in this area is the ACE Study (Adverse Childhood Experiences Study, key authors Anda and Felitti, see [www.acestudy.org](http://www.acestudy.org)). In a very large community study (26,000 participants, 71% response rate, > 20 year follow-up), it was expected that individuals with a higher number of adverse childhood experience categories (e.g. Physical abuse + witnessing domestic violence + parent substance abuse) would have more mental illness and alcohol abuse as adults. This was overwhelmingly confirmed. What was less expected was these individuals also had significantly worse general health. For example the emotional abuse group had a 1.7 times increase in cardiovascular illness. Overall the group experiencing multiple adverse childhood experiences had a 20 year lower life expectancy than the remainder of the cohort.

In summary the power of biological research techniques has undergone a spectacular change during recent history. This technology is beginning to be applied to individuals who have been abused or neglected. The findings, which in some cases need to be replicated, provide a major reason to be concerned. There is evidence abused children or those who experienced very prejudicial parenting may have structural brain damage across several crucial brain areas, which makes them more likely to experience a mental illness or disorder. As well as an increased likelihood of displaying limited coping to the normal stressors of life. At the same time this group has an altered gene function, mediated by a different mechanism, making them more reactive and less able to cope with usual stressors. Whilst there are clear mental health implications of these changes, research of physical outcomes finds these changes are not restricted to the brain, rather various body systems and are ultimately manifest as an over-all decreased life expectancy. Clearly these are persuasive arguments for intervening as early as possible and paying special attention to any young women with an abuse past who is either pregnant or has a young child.

  
  
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November 2012