


Applied Cognition & Neuroscience

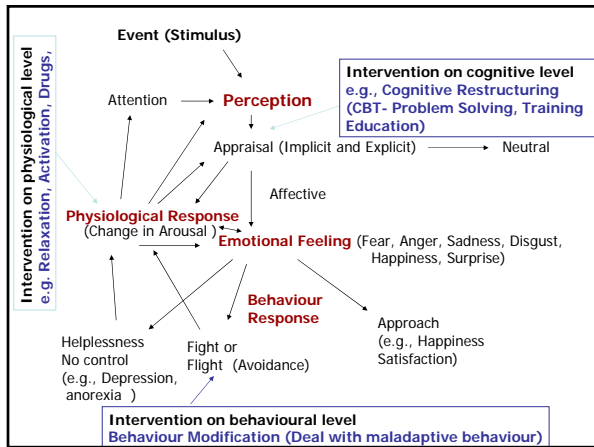
Mātai hinengaro whaipanga

Tuesday, 12 March 2008

The Physiology of Predicting Human Performance

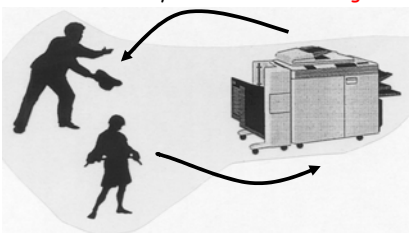


Lecture notes: Dr Robert Isler

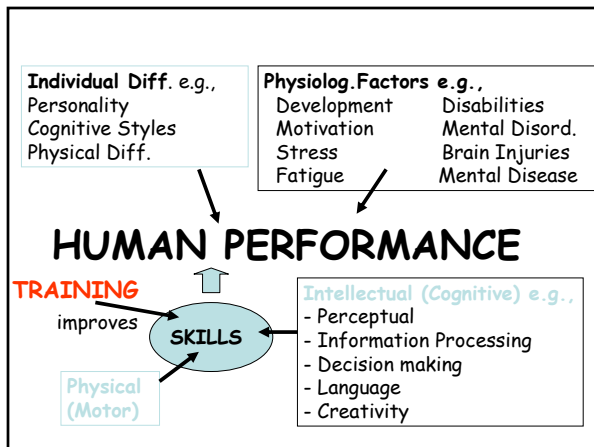


Knowing the human characteristics and capabilities:

How Machines, products, systems and environments can be made more user friendly: **Human Factors/Ergonomics**



People can be trained to improve the quality of their interactions with machines, products, systems and environments: **Human performance**



The Physiology of Predicting Performance

Is there anything like a :

- The happy brain
- The diseased brain
- The crocodile brain
- The brilliant brain
- The female/male brain
- The self confident brain
- The abused brain
- The violent brain
- The teenage brain
- The anxious brain
- The depressed brain
- the sporty brain

The Nature versus Nurture debate

Behavioural genetics: an interdisciplinary field that studies the influence of genetic factors on behavioural traits

Dick and Rose (2002)
 "Genes confer dispositions, not destinies"

Behavioural Neuroscience:

BEHAVIOUR

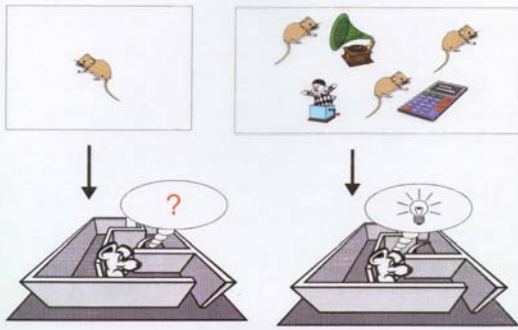


Brain Activity
 Including
 Mental Processes
 (Mind)

The relationship between the Behaviour and the Brain is **reciprocal**. Both affect each other.

The Brain has the capacity to alter its functioning in response to the **Behaviour** it produces and the **Environment** it is living in.

Enriched Environment (Rosenzweig, 1984)



Early life abuse affects brain

NEGLECT and abuse early in life can significantly affect children's health and well-being, according to research by Dr. Bruce Perry, chief of psychiatry at Texas Children's Hospital, found a research team at the University of Texas at Houston.

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The Perry, chief of psychiatry at Texas Children's Hospital, found a research team at the University of Texas at Houston, on Monday that an eight-year study of maltreated children showed their brains were biologically different from other children.

"We are among the first researchers to look at stress among and brain chemistry and responses among children who had been victims of abuse in families."

"What we have found is that the neurological changes in early part of the life - some children are biologically different, and there's a difference in ways they think. It is very hard to measure."

Dr. Perry's research team has looked at physical, emotional and cognitive aspects of 200 children aged 8 months to 12 years.

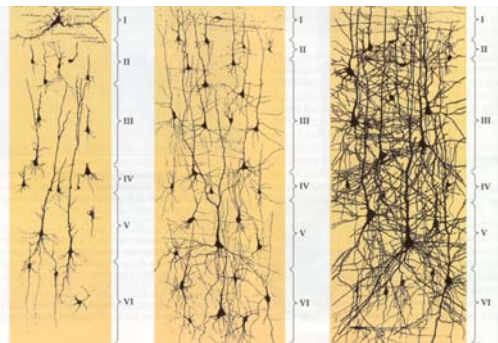
Dr. Perry's research team studied neglected Houstonian orphans and their American families, children who have suffered traumatic events such as fire and car accidents, and children who have been neglected or abused by their parents.

"We have found that stressful experience in childhood influence the physiology of the body and brain and these children are at risk for poor outcomes in adulthood," he said.

"It goes back at the children who have been mistreated by their parents and put into foster care. Their care of children in four times."

<http://www.childtrauma.org>

Perry's article:
 violence and childhood



Newborn

Three-month-old

Adult

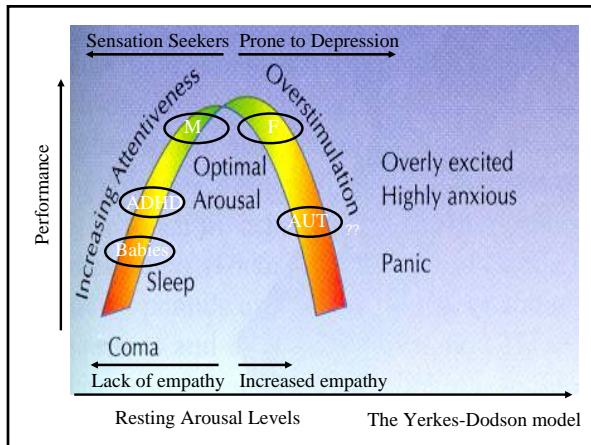
The myth of innate talents...



Open Peer commentary



James R. Flynn
New theory on intelligence



Experience



- Practising a skill re-organises the brain
- Paying attention to anything releases dopamine, which then acts on brain areas to expand the representation of stimuli active at the time of dopamine release.

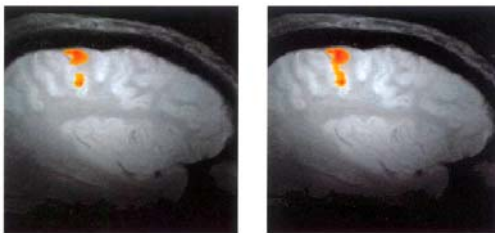
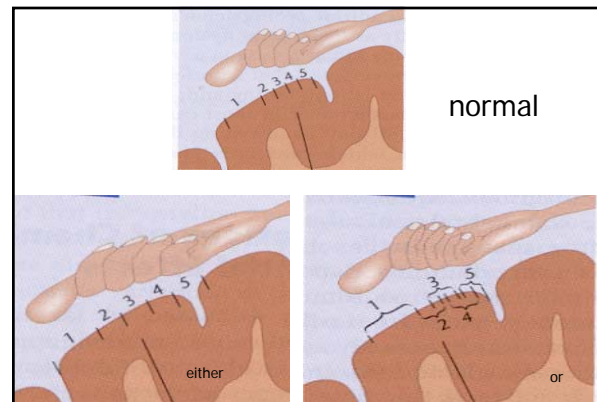
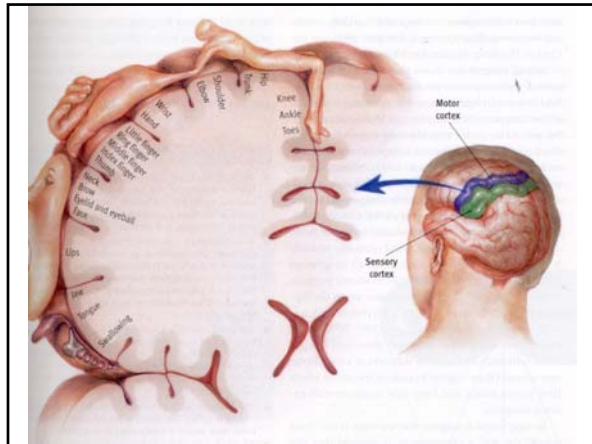


FIGURE 3.6
A trained brain
A well-learned finger-tapping task activates more motor cortex neurons (orange area, right) than were active in the same brain before training (left).



After lots of practice



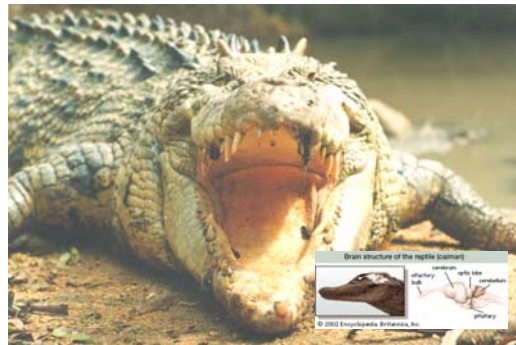
The happy brain: a myth?

The diseased brain

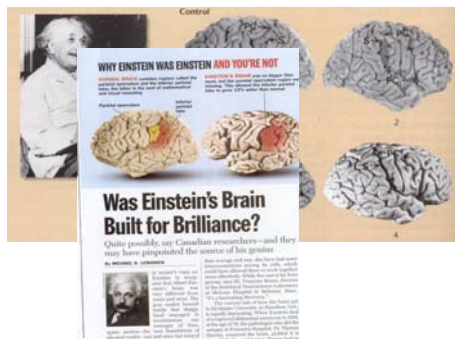


Huntington's disease (right):
Motor symptoms usually begin with arm jerks and then facial twitches; later, tremor spread to other parts of the body

The crocodile brain

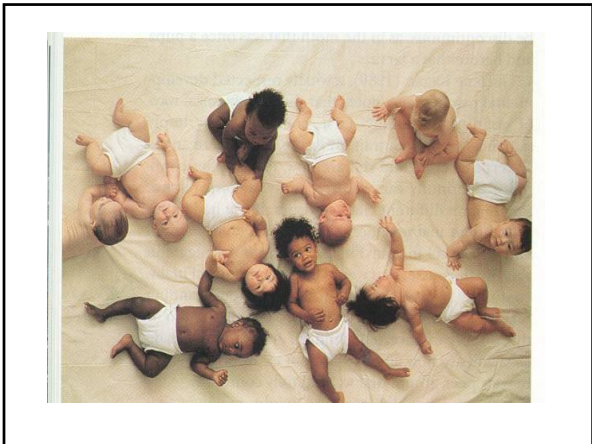


The brilliant brain

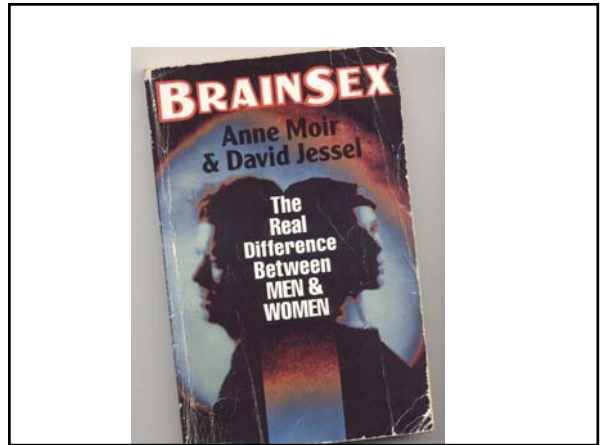
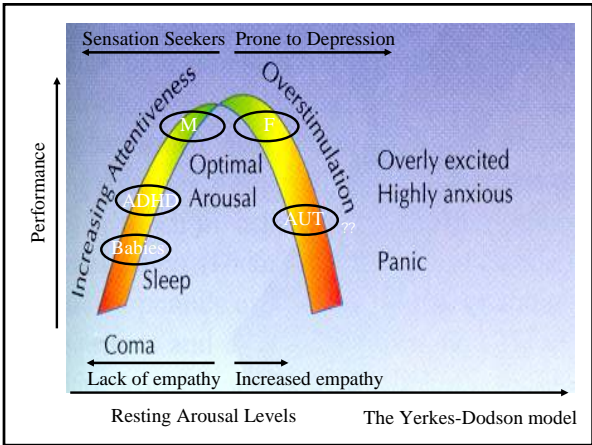
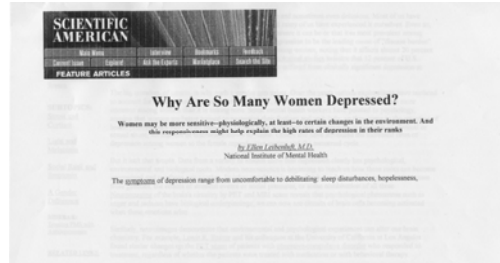


Einstein's Brain

- Normal in total size
- The Parietal Operculum is absent in Einstein's brain because the inferior parietal lobe expanded occupying area of Parietal Operculum
- High ration of glia to neurons
- Explanations? Causality?

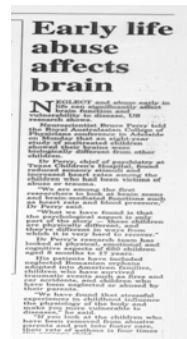


The female/male brain



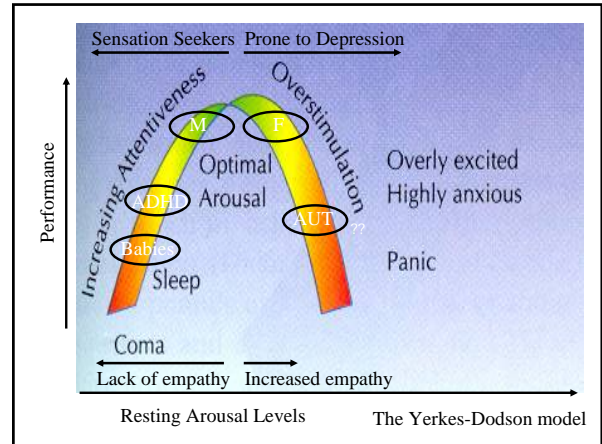
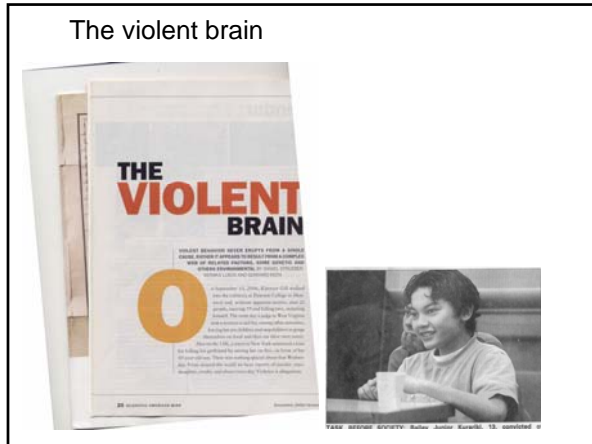
The self confident brain

The abused brain



<http://www.childtrauma.org>

Perry's article:
violence and childhood



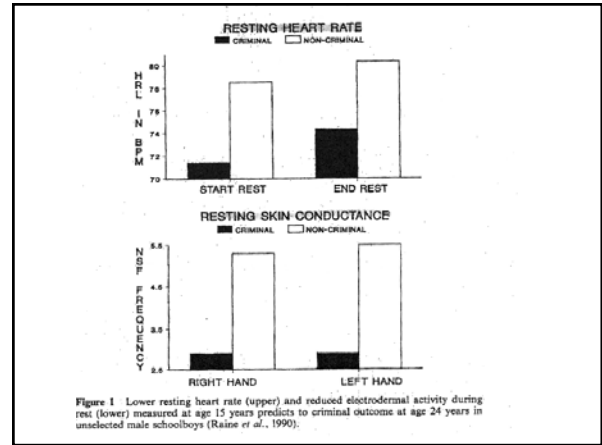
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BIOLOGICAL PREDISPOSITIONS TO VIOLENCE AND THEIR IMPLICATIONS FOR BIOSOCIAL TREATMENT AND PREVENTION

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This paper (a) describes four recent examples of biological risk factors for violence and crime, (b) outlines their implications for violence treatment and prevention, and (c) espouses a biosocial health perspective for developing more successful violence treatment services. The first study shows that low levels of physiological arousal at age 15 years in male schoolchildren predisposes to criminal and violent offending at age 24 years. The second study indicates that antisocial adolescents who desist from crime in adulthood are characterized by particularly high levels of arousal, orienting, and classical conditionability. The third study demonstrates that severely violent adult offenders are characterized by dysfunction to the prefrontal regions of the brain. The fourth study shows that birth complications interact with maternal rejection at age 11 years in predisposing to violent crime at age 18 years. The new intervention implications suggested by these findings consist of (a) prefrontal training to increase arousal levels

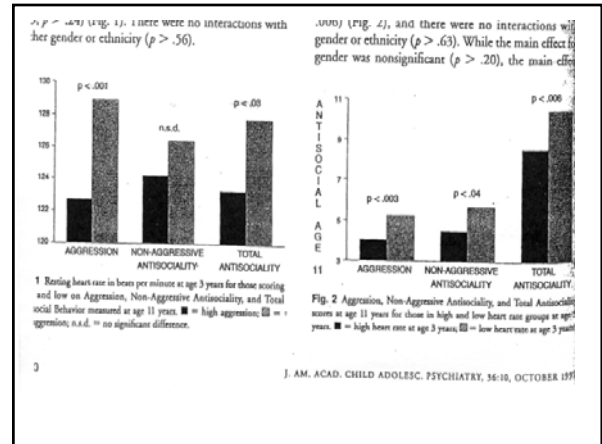


Low Resting Heart Rate at Age 3 Years Predisposes to Aggression at Age 11 Years: Evidence From the Mauritius Child Health Project

ADRIAN RAINE, D.PHIL., PETER H. VENABLES, PH.D., D.SC., AND SARNOFF A. MEDNICK, PH.D., D.MED.

ABSTRACT

Objective: Previous studies indicate that low resting heart rate is probably the best-replicated biological correlate of childhood antisocial and aggressive behavior. Nevertheless, there have been few longitudinal tests of this relationship, little control over potential confounds and mediators, and no test of its cross-cultural generalizability. This study tests the hypothesis that low resting heart rate at age 3 years predicts aggression at age 11 years. **Method:** Resting heart rate at age 3 years was assessed in 1,795 male and female children from Mauritius. Aggressive and nonaggressive forms of antisocial behavior were assessed at age 11 years using the Child Behavior Checklist. **Results:** Aggressive children had lower heart rates than nonaggressive children ($p < .001$). Conversely, those with low heart rates were more aggressive



Is there a link between genotype, maltreatment and violence ?

What causes violence ?

Psychology has over the last few decades developed a number of theoretical models to explain violent behaviour, particularly domestic violence.

These models can be fitted on to a continuum that links nature at one end and nurture at the other end.

- **Nature** end; believe that people (men) have little or no control over their violent behaviour.
 - relief of frustration based.
- **Nurture** end; believe that people (men) have very good or complete control over their violent behaviour.
 - power and control based.

So What's New ?

Role of Genotype in the
Cycle of Violence in Maltreated Children
By

Caspi, McClay, Moffitt, Mill, Martin, Craig, Taylor & Poulton

from London, Wisconsin and **Dunedin**.

was published in Science Volume 297 2 August 2002

Purpose

“ To determine why some children (boys) who are maltreated grow up to develop antisocial behaviour, whereas others do not.”

Method

The study was conducted in two parts.

- 1/ The Dunedin Multidisciplinary Health and Development Study.
- 2/ The identification of a gene on the X chromosome

The Dunedin Multidisciplinary Health and Development Study (DMH&D)

This is a longitudinal study which is based on a cohort of 91% of the children born in Dunedin between April 1972 and March 73

They have had follow up studies at age 3,5,7,9,13,15,18,21 and 26 (96%)

Among the issues studied by the DMH&D were

- **Childhood Maltreatment** (3-11 y.o.)
evidence was obtained from behavioural observation, parental reports and retrospective reports from members on reaching adulthood.
- **Antisocial behaviour outcomes in adolescence and in adulthood**

Antisocial behaviour outcomes in adolescence and in adulthood

A “common factor model” was used.

- Conduct disorder –DSM-IV
- Convictions for violent offenses
- Multidimensional Personality Questionnaire –
 - top quartile
- Informants reporting symptoms of ASP.
 - top quartile

DNA samples were obtained from the DMH&D participants.

At the age of 26 samples were taken from 97% of those still alive or 953 individuals.

51% were male.

The study originally began with 1,037 children

The identification of a gene

- The MAOA gene is on the X chromosome.
 - Coordinates Xp11.23-11.4
- Monoamine oxidase A (MAOA) encodes the MAOA enzyme, which renders inactive such neurotransmitters as,
 - Norepinephrine (NE)
 - Serotonin (5-HT)
 - Dopamine (DA)by metabolizing them.

“The Null Allele” (N.A.)

- A mutant version of this gene fails to produce adequate levels of MAOA enzyme..
- Previous research on mice and humans showed an increase in levels of
 - Brain NE, 5-HT & DA and
 - Aggression

(A null allele is a mutant copy of a gene that completely lacks that's gene's normal function)

The Hypothesis

- The researchers reckoned that,

“Maltreated children with a genotype conferring high levels of MAOA expression were less likely to develop antisocial problems.”

The Categories

The 442 male participants were placed in 2 groups.

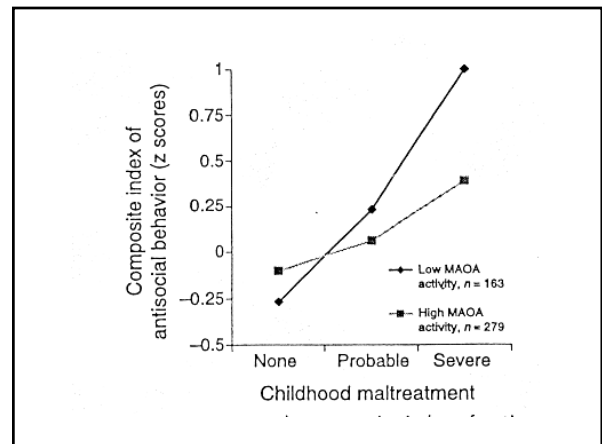
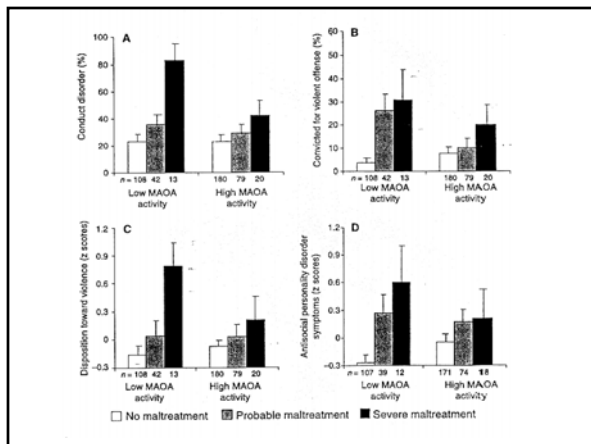
- Low MAOA activity
 - 163 in total 37%
 - No maltreatment 108
 - Probable maltreatment 42 (9.5%)
 - Severe maltreatment 13 (3%)
- High MAOA activity
 - 279 in total
 - No maltreatment 180
 - Probable maltreatment 79
 - Severe maltreatment 20

The Results for Severe Maltreated Males

- 80% with the null allele had Conduct Disorder v 40% for the normal allele. **Supports hypothesis.**
- 30% had a conviction for violent offences by 26 v 20% for the normal allele.
- 85% with the n.a. had developed some form of ASP
- Together with probable maltreated (12.5%) they had 44% of all their cohorts convictions for violence.

The Results for Non Maltreated Males

- Little or no difference between those with normal or the deleterious allele.
- Only 20% with n.a. had conduct disorder V 80% for severe maltreatment.
- Convictions for violence were lower for n.a than for those with normal (protective) allele.



IMPLICATIONS

- Potentially millions spent on Justice could be saved.
- Remove allele from gene pool ?
- Identify babies with allele and impose strict guidelines and restrictions on those parents ?
- Change society to make childrearing the most important task and
 - » Repeal section 59 of the Crimes Act

The teenage brain



A work in progress

Dahl (2004). The health paradox of adolescence

"Compared to young children, adolescents are stronger, bigger, and faster, and achieving maturational improvements in reaction time, reasoning abilities, immune function, and the Capacity to withstand cold, heat, injury, and physical stress. In almost every domain, this is a developmental period of strength and resilience"

"At the same interval of time: overall morbidity and mortality rates increase 200%"

"The major sources of death and disability in adolescence are related to difficulties in the control of behaviour and emotions"

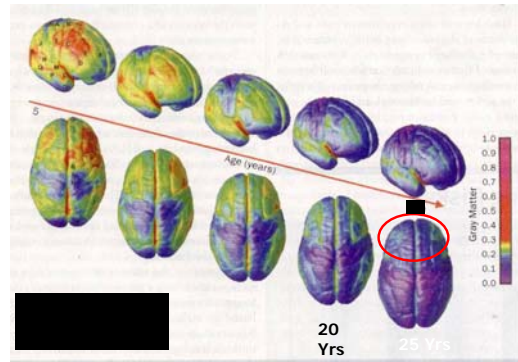
Cold cognitions versus hot cognitions

The teenage brain: A work in progress



From the Time Magazine

- Frontal Lobe:**
Executive Functions
- Inhibition
 - Planning ahead
 - Impulse control
 - Risk Management
 - Reasoning
 - Self Monitoring
 - Verbal self-regulation
 - Emotion regulation
 - Motivation
 - Hazard Perception
 - Eye Movements



Source: Dynamic mapping of human cortical development during childhood through early adulthood, by Nitin Gogtay et al., In PNAS, Vol 101, No.21: May 25, 2004.

The depressed brain

The sporty brain



PSYC305 – Applied Cognition &
Neuroscience

Thursday, 14 March 2008

- Psychophysiology
- Information on Laboratory 3