Neuro-developmental Maturity, trauma and violence: Causal links and interventions

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Conflicts of Interest/ Funding

• GW4 Universities Funding
  • re: Neuroimaging of Concussion (Exeter, Cardiff, Bath & Bristol)
• Medical Research Council – Global Challenge TRACES
  – (TRAuma in Childhood ExperienceS)
• Policy Group – Division of Neuropsychology, British Psychological Society
• Contributor - All Party Parliamentary Group on TBI
  • http://ukabif.org.uk/blog/2017/12/05/all-party-parliamentary-group-for-acquired-brain-injury-launch-meeting/
• Contributor – Global Study on Children Deprived of Liberty – Medical Group
• Pink Concussions Board
  • http://www.pinkconcussions.com/
Re-offending is very high in young, vulnerable people

- **Prolific offenders (PO) rates are closer to 80% (MOPAC)**
  
  PO tend to be early starters & go on to commit 77% of crime (see Farrington et al. 2006)

“Re-conviction rate for young offenders **discharged from custodial sentences** of less than 12 months was 71.9 per cent”

Offenders often have “Thinking” problems

“Offenders cope poorly with life because they exhibit various ‘cognitive deficits’”

- lack impulse control
- poor at controlling emotions
- poor problem solving
- rigid and inflexible thinking
- don’t recognising consequences of behaviour *
- can’t see another person’s perspective

  • **Perspective taking, empathy ?Theory of mind**

Longitudinal representative survey of 2,919 Young Adult offenders (violence, theft, burglary..serving community orders) over four-fifths of offenders had problems with recognising the consequences of their actions  (Cattell et al, 2013)

About a quarter of inmates are between: 15-24 yrs of age

Teenage brain – modules in a muddle

- “Such ‘peaks’ are – like iceberg tips – only a small indication of the complexity of the underlying changes happening in brain systems and their related cognitive and emotional functions.”
  - Williams 2012

- Teenage brain - adult-like ability to reason, but heightened need for reward (meso-limbic “reward sensitivity”) lower capacity to buffer immediate influences
  - POOR ON CONSIDERING CONSEQUENCES OF BEHAVIOUR & RISKY DECISION MAKING:
    - ‘starting the engines without a skilled driver behind the wheel’.

-Savage, 2009

- **dorsolateral prefrontal cortex**
  - circuitry sub-serving control of impulses & judgment
  - late to reach adult levels of cortical thickness

- gray matter maturation over the cortical surface.
  - [http://www.loni.ucla.edu/~thompson/DEVEL/dynamic.html](http://www.loni.ucla.edu/~thompson/DEVEL/dynamic.html)

- % of Maturation Increments - All Brain Regions
  - Age (years)
  - 1 3 5 7 9 11 13 15 17 19 21
  - 0 2 4 6

- [Image of brain maturation graph and related text]
Moderate-Severe TBI
(30 mins Loss of Consciousness)

- insult to the brain from an external mechanical force.
  e.g. blow to the head - “fast-stop” in a crash, assault, fall. Leading to: Contusions, lacerations, diffuse injury (e.g. diffuse axonal shearing)

- frontal and temporal most common sites of injury

MILD TBI – same mechanisms – with more “dosage” (e.g. repeated injury, 10-30 LOC) = more likely problems
Rates of Traumatic Brain Injury:

12% (adults) may have had a TBI with a LOC at some point

(Frost et al, 2013)

Yates, Williams et al: Attendance rates for moderate to severe head injury per 100,000 population Age, gender, urban location and social deprivation as key risk factors
Traumatic brain injury (TBI) is a leading cause of disability in all regions of the globe. (Bryan-Hancock et al, 2010; Roozenbeek 2013)

TBI estimated at 200 per 100,000 PA

In Mid & Low Income/Resource States (MILRS) Data scarce BUT there is a higher incidence rates from these regions.

EG incidence rate of TBI in South Africa has been estimated at 1.5 to 3.5 times that of the estimated global rate.

‘Silent epidemic’, as society is largely unaware of the magnitude of this problem – especially in MLRS

By 2020, 10 MILLION people affected PA worldwide (WHO) (Hyder, 2007)

https://www.thelancet.com/pdfs/journals/laneur/PIIS1474-4422(17)30371-X.pdf
TBI & the “Social-Brain”

TBI commonly involves pathology to anterior brain regions implicated in social cognition (Tasker et al., 2005; Wilde et al., 2005), as well as diffuse axonal injury (DAI) which may disrupt formation of white matter connections between regions that contribute to the distributed ‘social brain’ network, including the superior temporal sulcus, fusiform gyrus, temporal pole, medial prefrontal cortex, orbitofrontal cortex, amygdala, temporoparietal junction and inferior parietal cortex (Beauchamp and Anderson, 2010; Johnson et al., 2005; Yeates et al., 2007).

Ryan et al, 2013
How ABI children perform on Theory Of Mind compared to non-injured children?

Tonks, Williams, Frampton et al.
TBI & “Personality Change” in children and young people

**Moderate to Severe TBI: (20% approx)**

Cognition – attention, memory, executive, social cognition

Behaviour – dis-inhibition, anger, etc

Mood – depression, anxiety…

(Hawley, 2003; Anderson et al 2006; Max, 2001; Tonks et al, 2010)

94 children with TBI aged 9 at time of injury:

**Organic Personality Change (OPC)**

In 57% of severe & 5% mTBI labile and aggressive OPC subtypes most common – 3-4 x more.

141 kids, **22% (6 months)** had PC – assoc. w. dorsal prefrontal lobe injury (Max, 2005)

Therefore **3 or 4 in 10** affected

NOTE: EFFECTS MAY BE DELAYED

**Mild TBI: (80% approx)**

“complicated”, or cumulative, injury may be linked to: problems in attention and inhibitory control (Williams, Potter & Ryland, 2010; Wall, Williams et al, 2006; Williams et al, 2012)

**Difficulties considering alternative behaviours & controlling impulses** (Fishbein 2009 et al; Pontifex 2009)

**Novel Psychiatric disorders (NPD)**

- 70 children with MTBI
- 6 months post injury
- 36% : NPD

**ADHD, PC, Oppositional Defiant** (Max et al, 2013)

Injury = impulsivity, poor social skills, and externalising behaviours – therefore:

- disrupt development of prosocial life role
- underlie drift from classroom to the courtroom.
Risk of Crime after TBI:


• Swedish population registers from 1973 to 2009, and examined associations of epilepsy (n = 22,947) and traumatic brain injury (n = 22,914) with subsequent violent crime (convictions for homicide, assault, robbery, arson, any sexual offense, or illegal threats or intimidation)

  – “Among the major strengths of the study are.. very large sample size… entire population of Sweden, and the follow-up of 35 years… findings are of major public health importance and provide inspiration for further research” J Volavka (Commentary)

• traumatic brain injury cases, 2,011 individuals (8.8%) committed violent crime after diagnosis
• compared with population controls (n = 229,118 (5,504 controls – 2.5%)), corresponded to a substantially increased risk (adjusted odds ratio [aOR] = 3.3, 95% CI: 3.1–3.5)
• Risk was attenuated when cases were compared with unaffected siblings (aOR = 2.0, 1.8–2.3)
“Are children who experience TBI more likely to engage in criminal behaviour?”

McKinlay, A; et al (2010). Brain impairment

  - **Groups:** 1) MTBI “hospitalised”
    2) MTBI “Not hospitalised”
    3) “No- Injury”

- **Outcomes:** Ages 15-21: self-reported arrests, violent offences and property offences

- compared to non-injured individuals, both TBI groups were more likely to be arrested (relative risk (RR)=2.03 and RR=1.68), involved in property offences (RR=2.08 and RR=1.54) and violent offences (RR=1.35 and RR=2.29) (all p<0.01).

- **Nb. Evidence of problems at school within 2 years, and exclusion in teenage years**

“clear evidence of ongoing problems for [those who] had...a TBI compared to their non injured counterparts”.

Related study:
Injury pre 5 years = drug & alcohol problems mediates crime
Injury at 5yr and later = direct relationship to crime

(McKinlay, 2013. JHTR)
Qualitative study of violent offenders, with routine CT and MRI scanning, showed that violent offenders had significantly greater number of neurological abnormalities, particularly involving the frontal lobes, compared to non-violent and non-offending controls.
% of Adult (Male) Prison Population Reporting TBI and Type and Time of Injury

We estimate that:
- 65% may have had TBI...
- 10% Severe
- 5.6% Moderate
- 49.4% Mild

Average age of first imprisonment:
- 16 Years – TBI
- 21 Years – non-TBI
TBI in Young Offenders in UK

Williams, Cordan et al (2010):
Youth offenders (YOI) (n = 192; 16 years of age)
- 65% history of “head injury”
- MTBI with LOC up to 10 minutes & moderate-severe TBI = 46% of overall sample
- 16.6% moderate to severe injury
  (LOC over 10 minutes)

Those with TBI = more convictions
3+ TBIs = more violence
TBI in offenders typically leads to...

- Poorer engagement in treatment
- Greater levels of infraction
- Higher level of re-conviction
- Often in areas of violence

Pitman: 139 w TBI v 50 non-TBI 60% vs 38% violent crime

Fishbein: 224 (71 TBI) pps TBI = early dropout & aggressive

Ray & Richardson 151 inmates Post release 1.6 higher rate of recidivism

References:
TBI in Young Offenders: CHAT (Comprehensive Health Assessment Tool) study
Chitsabesan et al. (2015)

- Consecutive admissions to Young Offender Institution (YOI)
- 93 adolescent males (15-18yrs)
  - Mean Age 16.5 years and 78% White-British

- Assessed:
  - Demographic and offending information
  - CHAT screens for TBI “event” and chronic TBI problems

Findings:
- 82% had a TBI
- 44% with “ongoing” symptoms
<table>
<thead>
<tr>
<th>Condition</th>
<th>No-Mild TBI</th>
<th>Moderate-Severe TBI (PCS based)</th>
<th>Odds Ratio</th>
<th>P Value</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total language score below average (&lt;84)</td>
<td>33 (41%)</td>
<td>5 (36%)</td>
<td>0.74</td>
<td>P=0.67</td>
<td>0.28-2.52</td>
</tr>
<tr>
<td>IQ below average (&lt;69)</td>
<td>8 (10%)</td>
<td>1 (7%)</td>
<td>0.68</td>
<td>P= 0.72</td>
<td>0.07-5.92</td>
</tr>
<tr>
<td>ADHD</td>
<td>15 (20%)</td>
<td>4 (29%)</td>
<td>1.62</td>
<td>P=0.45</td>
<td>0.45-5.90</td>
</tr>
<tr>
<td>Depression</td>
<td>5 (7%)</td>
<td>1 (7%)</td>
<td>1.09</td>
<td>P= 0.94</td>
<td>0.12-10.13</td>
</tr>
<tr>
<td>Self Harm</td>
<td>6 (43%)</td>
<td>8 (57%)</td>
<td>3.73</td>
<td>P=0.02*</td>
<td>1.1-12.09</td>
</tr>
<tr>
<td>Suicide risk factors</td>
<td>18 (24%)</td>
<td>7 (50%)</td>
<td>3.22</td>
<td>P=0.04*</td>
<td>0.99-10.41</td>
</tr>
<tr>
<td>Alcohol Misuse</td>
<td>44 (58%)</td>
<td>10 (71%)</td>
<td>1.81</td>
<td>P=0.34</td>
<td>0.52-6.31</td>
</tr>
<tr>
<td>Cannabis Misuse</td>
<td>64 (84%)</td>
<td>12 (86%)</td>
<td>1.12</td>
<td>P=0.89</td>
<td>0.22-5.67</td>
</tr>
<tr>
<td>Been in Care</td>
<td>26 (34%)</td>
<td>9 (64%)</td>
<td>3.46</td>
<td>P=0.03*</td>
<td>1.05-11.39</td>
</tr>
<tr>
<td>Violent offences</td>
<td>49 (64%)</td>
<td>9 (64%)</td>
<td>0.92</td>
<td>P=0.98</td>
<td>0.30-3.26</td>
</tr>
<tr>
<td>Previous history of custodial sentences</td>
<td>32 (42%)</td>
<td>6 (43%)</td>
<td>1.03</td>
<td>P=0.95</td>
<td>0.32-3.26</td>
</tr>
</tbody>
</table>

TBI in Young Offenders: CHAT (Comprehensive Health Assessment Tool) study Chitsabesan et al. (2015)
The prevalence of neurodevelopmental disorders in YP in custody
Hughes, Williams & Chitsabesan (2012)

<table>
<thead>
<tr>
<th>Neurodevelopmental disorder</th>
<th>Reported prevalence rates amongst young people in the general population</th>
<th>Reported prevalence rates amongst young people in custody</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning disabilities</td>
<td>2 - 4%</td>
<td>23 - 32%</td>
</tr>
<tr>
<td>Dyslexia</td>
<td>10%</td>
<td>43 - 57%</td>
</tr>
<tr>
<td>Communication disorders</td>
<td>5 - 7%</td>
<td>60 - 90%</td>
</tr>
<tr>
<td>Attention deficit hyperactive disorder</td>
<td>1.7 - 9%</td>
<td>12%</td>
</tr>
<tr>
<td>Autistic spectrum disorder</td>
<td>0.6 - 1.2%</td>
<td>15%</td>
</tr>
<tr>
<td>Traumatic brain injury</td>
<td>24 - 31.6%</td>
<td>65.1 - 72.1%</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>0.45 - 1%</td>
<td>0.7 - 0.8%</td>
</tr>
<tr>
<td>Foetal alcohol syndrome</td>
<td>0.1 - 5%</td>
<td>10.9 - 11.7%</td>
</tr>
</tbody>
</table>
Case illustration...

Young Person in YOI - England

- "John 17, Assault = ?TBI"
  - Notes = fractured skull, left side
  - Impulsive, poor concentrating, not engaging in regime, threatening & abusive to staff, other inmates
  - lowest privilege level due to poor pattern of behaviour
- NPsych Tested:
  - eg poor verbal memory (5%) – visual intact
  - co morbid ADHD, dyslexia, communication disorders
- Explore & Manage effects of brain injury - AMNESTIC
  - develop self-control & consequential thinking
  - use visual CUES to remind of time spent/ rewards
  - written guidelines and accessible reports for staff
  - Liaise with substance misuse worker, caseworker, mental health nurse etc

- Enable to engage in education
- Behaviour “reversed”
- on track for release
- REMINDERS needed

“We received compelling evidence that another important consideration for young adults in the criminal justice system is the potential presence of atypical brain development... those who persist in criminal behaviour into adulthood are more likely to have neuro-psychological deficits, including cognitive difficulties with thinking, acting, and solving problems, emotional literacy and regulation, learning difficulties and language problems associated [often due to] traumatic brain injury”

- Scottish Parliament – Justice Committee report on TBI & Prisons (Tom McMillan)

- UK Parliament
Actions...some in progress

- **PREVENTATIVE Interagency working**
  - Education, Health, Social & Justice

- **SENTENCING**
  - Identify ND in youth & young people justice systems
    - New Zealand model see: UN Convention on Rights of People with Disability – Judge Becroft
    - Sentencing Council UK – need to take account of maturity – and TBI issues – effective June 2017

- NEURO-REHAB that’s TRAUMA INFORMED (Probation/Prison)
  - Identify ND in youth justice systems
    - Brain Injury Link-workers
    - Train staff to be AWARE etc.
  - Develop Trauma & ND informed approaches
    - Welsh Youth Justice Board – Clinical Psych/Neuro Formulation approach
    - NHS England & MoJ “Secure Stairs” model for YOI
    - Ministry of Justice: Pilots...re: TBI to be screened for 6 Prison Pilot linkworker projects funded & Training of court staff to consider alternative rehabilitation pathway


Investing in development: (Spending to save)

- Children and young people MOST likely for TBI least likely to get support
  - They do NOT grow out of their problems, BUT probably into them...especially when in adverse environments

- School inclusion & diversion/liaison processes vital

- Parent/Care-giver support important

- Screening for TBI (Neuro-disability) is possible
  - sentencing, custody, sentencing, entry to secure estate, re-settlement

- Neuro-rehabilitation can be done within prisons & probation...
REPORT TO CONGRESS

The Management of Traumatic Brain Injury in Children: Opportunities for Action
Journal Articles:


Chitsabesan, Prathiba; Lennox, Charlotte; Williams, Huw; Tariq, Omar; Shaw, Jenny, W. H. (2015). Traumatic Brain Injury in Juvenile Offenders: Findings From the Comprehensive Health Assessment Tool Study and the Development of a Specialist Linkworker Service. J Head Trauma Rehabil, 30(2),


Policy Reports etc. CLICK LINK FOR REPORT:
Overview for practitioners and policy makers and practitioners on TBI & Crime, Repairing shattered lives (French version also available); British Psychological Society (BPS) working group on Neuro-Disability in children and young people in custody; Nathan Hughes a report on Neuro-disability and TBI in young offenders in children in custody for the Office of the Children's Commissioner infographic to illustrate the links between TBI and crime; Dr Prathiba Chitsabesan, a report on the use of linkworkers for young offenders to manage TBI in custody.
Centre for mental health in producing a report on the economic costs of crime due to TBI. Journal of Head Trauma Rehabilitation on TBI & Crime in young people